Q
11
U563
CRLSSI

SHOUT
SHARE
IT

United States National Museum
Bulletin 214

Review of the Parrotfishes Family Scaridae

By LEONARD P. SCHULTZ
Curator of Fishes
United States National Museum

SMITHSONIAN INSTITUTION • WASHINGTON, D. C. • 1958

Publications of the United States National Museum

The scientific publications of the National Museum include two series known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings* series, begun in 1878, is intended primarily as a medium for the publication of original papers based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The series of *Bulletins*, the first of which was issued in 1875, contains separate publications comprising monographs of large zoological group and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

The present work forms No. 214 of the *Bulletin* series.

REMINGTON KELLOGG,
Director, United States National Museum.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 75 cents (paper)

Contents

Page

Introduction 1
Family Scaridae 15
Key to the genera and subgenera of Scaridae 16
Subfamily Scarinae 18
Scarops, new genus 18
Key to the species of the genus *Scarops* 19
Scarops, new subgenus 21
rubroviolaceus (Bleeker) 21
jordani (Jenkins) 21
Xenoscarops, new subgenus 23
perrico (Jordan and Gilbert) 23
Genus *Chlorurus* Swainson 25
Key to the species of the genus *Chlorurus* 26
gibbus (Rüppell) 26
bicolor (Rüppell) 27
pulchellus (Rüppell) 28
nigripinnis (Playfair and Günther) 29
Genus *Scarus* Forskål 29
Key to the species of *Scarus* of the Tropical Pacific and Indian Oceans 33
Ypsiscarus, new subgenus 47
oedema (Snyder) 48
Subgenus *Scarus* Forskål 48
microrhinos Bleeker 48
harid Forskål 50
javanicus Bleeker 52
flavipectoralis, new species 52
dubius Bennett 54
lunula (Snyder) 54
formosus Cuvier and Valenciennes 56
lauia Jordan and Evermann 57
perspicillatus Steindachner 57
schlegeli (Bleeker) 59
venosus Cuvier and Valenciennes 60
taeniurus Cuvier and Valenciennes 61
forsteri Cuvier and Valenciennes 64
cyanescens Cuvier and Valenciennes 66
rhoduropterus (Bleeker) 67
troscheli Bleeker 67
bleekeri (Weber and de Beaufort) 68
sordidus Forskål 68
bowersi (Snyder) 72
jonesi (Streets) 72
capistratoides Bleeker 74

Family Scaridae—Continued Page
Subgenus *Hemistoma* Swainson 74
dimidiatus Bleeker 74
africanus (Smith) 75
globiceps Cuvier and Valenciennes 75
brevifilis (Günther) 76
singaporensis Bleeker 78
rubrofasciatus (Smith) 79
atropectoralis, new species 79
lepidus Jenyns 81
fasciatus Cuvier and Valenciennes 82
vermiculatus (Fowler and Bean) 82
frenatus Lacépède 83
janthochir Bleeker 83
ghobban Forskål 84
guttatus Bloch and Schneider 85
chlorodon Jenyns 86
marshalli, new species 88
azureus Meek and Hildebrand 89
noyesi Heller and Snodgrass 90
californiensis (Pellegrin) 91
scaber Cuvier and Valenciennes 92
oviceps Cuvier and Valenciennes 93
niger Forskål 93
madagascariensis (Steindachner) 94
blochi Cuvier and Valenciennes 95
aeruginosus Cuvier and Valenciennes 96
randalli, new species 97
pectoralis Cuvier and Valenciennes 99
dussumieri Cuvier and Valenciennes 100
Key to the species of *Scarus* of the Atlantic 101
vetula Bloch and Schneider 103
guacamaia Cuvier 104
coelestinus Cuvier and Valenciennes 105
coeruleus (Bloch) 106
croicensis Bloch 106
hoefleri (Steindachner) 109
Subfamily Sparisomatinae 109
Genus *Scaridea* Jenkins 109
zonarcha Jenkins 109
Genus *Sparisoma* Swainson 110
Key to the species of the genus *Sparisoma* 110
radians (Cuvier and Valenciennes) 113
viridis (Bonaterre) 114
aurofrenatum (Cuvier and Valenciennes) 115
axillaris (Steindachner) 117
rubripinnae (Cuvier and Valenciennes) 118
chrysopterum (Bloch and Schneider) 120
abildgaardi (Bloch) 121

Family Scaridae—Continued Page
Genus *Calotomus* Gilbert 123
Key to the species of the genus *Calotomus* 123
spinidens (Quoy and Gaimard) 124
japonicus (Cuvier and Valenciennes) 125
Genus *Leptoscarus* Swainson 126
vaigiensis (Quoy and Gaimard) 126
Genus *Cryptotomus* Cope 127
roseus Cope 127
Genus *Nicholsina* Fowler 128
Key to the species of the genus *Nicholsina* 128
ustus (Cuvier and Valenciennes) 128
denticulatus (Evermann and Radcliffe) 129
Genus *Euscarus* Jordan and Evermann 129
Key to the species of the genus *Euscarus* 130
cretensis (Linnaeus) 130
strigatus (Günther) 130
Addenda 131
Index 133

REVIEW OF THE PARROTFISHES FAMILY SCARIDAE

By Leonard P. Schultz

Introduction

This review of the parrotfishes of the world was undertaken in order more correctly to identify and understand the relationships of those species encountered during the preparation of volume 2 of U. S. National Museum Bulletin 202, "Fishes of the Marshall and Marianas Islands." It is based principally on the several thousand specimens, together with many photographs and drawings in color, in the collections of the U. S. National Museum, and on my own color notes and sketches made from live parrotfishes.

Additional specimens were loaned by Drs. Reeve M. Bailey, University of Michigan; Loren P. Woods, Chicago Natural History Museum; and Norman B. Marshall, British Museum (Natural History). Dr. Robert R. Harry loaned all the material recorded from Ifaluk, Kapingamarangi, and Raroai Atolls. Drs. James Böhlke, Academy of Natural Sciences of Philadelphia, Howard A. Winn, University of Maryland, and John E. Bardach, University of Michigan, through the loan of their recently collected specimens from Bermuda and the Bahamas, together with their notes and personal observations, made it possible to work out the sexual dichromatism in *Scarus croicensis* and *Sparisoma aurofrenatum*. In late 1953 I was able to study the types of parrotfishes in the British Museum (Natural History), the Indian Museum, in Calcutta, and the Museum National d'Histoire Naturelle, in Paris. To the authorities of these institutions and to my colleagues who have been so helpful I wish to express my appreciation for their kindness. And especially for their cooperation in supplying fresh material before the color patterns faded, I extend particular thanks to Vernon Brock, Richard Rosenblatt, and Drs. William A. Gosline, Bruce Halstead, Robert R. Harry, John Randall, Donald Strasburg, and Howard A. Winn.

For over a century the parrotfishes have been known as one of the most difficult and confusing families of reef fishes in systematic ichthyology, and no previous attempt has been made to revise them on a world basis. Recognition of species in this family is difficult and in many cases most uncertain. As is true of other reef fishes,

many of the descriptions in the literature are wholly inadequate, so that, in the absence of a carefully drawn illustration of the color pattern, it is almost impossible to recognize the species described.

The characters most useful in recognizing species of parrotfishes are (1) number of rows of teeth on the pharyngeal bones, (2) number of median predorsal scales, (3) number of rows of scales on the cheek, (4) number of scales in the ventral row on the cheek, (either second or third row, since in many species the third or ventral row is absent), (5) number of pectoral rays, and (6) the color pattern.

The usual counts of fin rays, scales, and gill rakers have been of limited value in the recognition of many species, leaving color pattern as the only usable character, a fact which greatly complicates identification of long-preserved or faded specimens. This problem was solved in part by the use of Kodachromes, fresh material, and color drawings; nevertheless, it was necessary to illustrate nearly every one of the 80 species herein distinguished. Color characteristics of the body are important, but so are the position and shape of the bands, blotches, and bars on the head. These generally vary among species more widely than do body colors, but at the same time they are more stable, and thus more characteristic, within each species. The number of streaks on the median fins is important, too.

While there is some variability in color pattern for each species, in all instances where a large series of a species was available, certain details of the color pattern were sufficiently constant so that the species could be recognized, even after long preservation. These characters are indicated in the key, in drawings and photographs, and in the short diagnosis given for each species.

Many species of parrotfishes pass through from one to three color phases, as indicated by Parr (Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, pp. 109–115, 1930). In general these are (1) juvenile, in which the color may consist of two or three alternating dark and light streaks; or spots that are dark or mottled pale and dark or plain in color, (2) immature, in which the color pattern is usually some shade of red or brown or purple, or the body may be dark spotted or mottled; (3) adult, in which the color pattern appears to be reached somewhat before or at sexual maturity, with the predominating colors generally green, blue, pink or red, orange, and yellow. A few species are brownish; some of these are females, but the males of the species predominate in shades of green or blue. Certain species may never have the adult or "green" color phase but the majority studied did.

In several species sexual dichromatism is indicated, for example in *Scarus sordidus* and in *S. perspicillatus*. In the latter it has been proven without doubt by Vernon Brock and Y. Yamaguchi (Copeia, No. 2, pp. 154–155, 1954) that the males possess characteristic blue

or green markings lacking on the females. One of the difficulties encountered in pursuing these studies has been the general disintegration of the viscera in museum specimens, making it impossible to recognize their sex. What is needed is a field study on fresh specimens that will make it possible to relate sex to color markings, as was done by Dr. Winn for *Scarus croicensis* and *Sparisoma aurofrenatum* at Bermuda in 1956.

Although the color pattern is a highly suitable character for recognizing species at nearly all sizes, there are other characters that have been evaluated as to their constancy and have been found not to vary significantly among all the species studied. These are (1) number of dorsal, anal, caudal, and pelvic fin rays; (2) number of scales from rear of head to base of caudal fin; (3) for fish of certain species, the relation of increase in size to the number of canine teeth near the corner of the mouth, the number appearing to increase from none to 2 or 3. The color of the teeth are only partially valuable in recognizing species, since the teeth may change from whitish or pinkish in the immature, to green in mature adults, or they may be white or green at sizes greater than the juvenile stage. In the juvenile stage the teeth are usually white.

Proportional measurements were made on various species of *Scarus* in an attempt to evaluate that type of measurement for recognizing species. It was concluded that such measurements gave little help except for a few species such as *Scarus harid*, with its longer snout, but that species can be identified by better characters.

Another character by which certain parrotfishes have been considered a distinct species is the swelling or enlargement of the forehead. While this oedematous enlargement is useful for a few species, it has its limitations, since it enlarges with increase in size and on some species occurs only on the largest adults, measuring 15 inches and longer, or on males.

The pharyngeal mill of parrotfishes is designed to crush coralline algae, coral fragments and other food items. The upper pharyngeals are paired and fit snugly against the base of the skull. The number of rows of teeth on each upper pharyngeal bone may vary from one to three and is almost invariable for groups of species. The lower pharyngeals consist of a single bone, with a flat or concave dentigerous surface that opposes the two upper pharyngeals; powerful muscles, attached to the shoulder girdle and base of the skull, have further leverage by attachment to a secondary bone, one of the epibranchials (Monod, Bull. Soc. Hist. Nat. Toulouse, vol. 8, pp. 191–194, 1951) located just behind the last gill arch. Although Boas (Die Zähne der Scaroiden, Zeitschr. Wiss. Zool., vol. 22, pp. 189–210, pl. 10, 1879) studied the teeth of parrotfishes, his material was limited

to a few species (whose identity must be doubted) and the paper contributed little toward the solution of generic analysis.

I have studied the pharyngeal bones of numerous species and have found that the differences among groups of species are useful in recognizing genera. The following species were so studied; some of them are illustrated on plates 1 to 5:

Scarops: microps, perrico, rubroviolaceus, and *jordani.*
Chlorurus: gibbus, bicolor, and *pulchellus.*
Scarus: aeruginosus, brevifilis, californiensis, coeruleus, compressus, croicensis, dimidiatus, dubius, forsteri, globiceps, guacamaia, harid, lepidus, microrhinos, niger, noyesi, oedema, perspicillatus, randalli, rhoduropterus, scaber, schlegeli, singaporensis, sordidus, vetula, and *madagascarensis.*
Scaridea: zonarcha.
Sparisoma: abildgaardi, chrysopterum, lorito, and *rubripinnis.*
Calotomus: spinidens, japonicus, and *xenodon.*
Leptoscarus: vaigiensis.
Cryptotomus: roseus.
Nicholsina: beryllinus, denticulatus, and *ustus.*
Euscarus: cretensis and *strigatus.*

Other species whose pharyngeal apparatus was not removed are referred to various genera on the basis of their close relationships with other species on which disections were made.

In order to determine the number of vertebrae,[1] radiographs were made for all recognized species in the family except *Chlorurus nigripinnis, Scarus cyanescens, S. africanus, S. rubrofasciatus,* and *S. guttatus,* for which no specimens were available. The radiographs of 708 specimens distributed among the genera and species, as recorded in table 1, all showed a total of 25 vertebrae, without variability.

After a study of prepared skeletons of parrotfishes it was possible to distinguish the abdominal vertebrae from the caudal vertebrae in the radiographs. The first vertebra with a fully developed haemal spine, or one that reached past the tips of the first few anal pterygiophores, was considered as the first caudal vertebra. It was found that the subfamily Sparisomatinae had 9 abdominal and 16 caudal vertebrae, whereas the subfamily Scarinae had 10 to 12 abdominal and 13 to 15 caudal vertebrae.

For all species in the subfamily Sparisomatinae, the ninth abdominal vertebra never had any trace of a haemal spine, whereas the next vertebra (the tenth, or first caudal) always had a fully developed haemal spine that reached past the tips of the first few anal pterygiophores.

In the subfamily Scarinae the tenth or eleventh or twelfth may or may not possess a rudimentary haemal spine, such a short spine

[1] The author is most grateful to the Research Corporation of New York for a grant that enabled him to equip an x-ray apparatus in the division of fishes for study of osteology.

being considered rudimentary if it arises in the usual position for the haemal spine but does not reach the next posterior vertebra. Some individuals had rudimentary haemal spines on the eleventh vertebra, but a rudimentary haemal spine was found on the twelfth vertebra only on *Chlorurus gibbus*. If a rudimentary spine occurred on the tenth or on the eleventh or twelfth vertebra the next posterior vertebra always had a haemal spine that extended to opposite or beyond the tips of the first few anal pterygiophores. All vertebrae with rudimentary haemal spines were counted as abdominal vertebrae.

The occurrence of rudiments of haemal spines suggests that the haemal spines in the subfamily Scarinae may be in the evolutionary process of becoming reduced in development or lost, thus increasing the number of abdominal vertebrae from 9 in the Sparasomatinae to 10 to 12 in the Scarinae.

TABLE 1.—*Number of vertebrae recorded from radiographs of genera and species of Scaridae*

Genera and species	Abdominal vertebrae [1]				Caudal vertebrae [2]				Total vertebrae	From anteriorly, the abdominal vertebrae on which a rudimentary haemal spine occurred		
	9	10	11	12	13	14	15	16	25	10	11	12
Chlorurus												
bicolor	—	1	7	—	—	7	1	—	8	—	4	—
gibbus	—	—	—	6	6	—	—	—	6	—	—	6
pulchellus	—	2	9	—	—	9	2	—	11	—	8	—
Scarops												
perrico	—	22	—	—	—	—	22	—	22	9	1	—
rubroviolaceous	—	10	—	—	—	—	10	—	10	6	—	—
jordani	—	4	—	—	—	—	4	—	4	3	—	—
Scarus												
oedema	—	2	9	—	—	9	2	—	11	—	7	—
microrhinos	—	3	17	—	—	17	3	—	20	3	12	—
harid	—	7	1	—	—	1	7	—	8	—	2	—
javanicus	—	—	8	—	—	8	—	—	8	—	5	—
flavipectoralis	—	—	1	—	—	1	—	—	1	—	1	—
dubius	—	2	9	—	—	9	2	—	11	—	6	—
lunula	—	8	—	—	—	—	8	—	8	3	—	—
formosus	—	12	1	—	—	1	12	—	13	8	4	—
lauia	—	—	2	—	—	2	—	—	2	—	2	—
perspicillatus	—	12	—	—	—	—	12	—	12	4	—	—
schlegeli	—	—	9	—	—	9	—	—	9	—	3	—
venosus	—	—	13	—	—	13	—	—	13	—	6	—
taeniurus	—	22	—	—	—	—	22	—	22	7	—	—
forsteri	—	9	—	—	—	—	9	—	9	2	—	—
rhoduropterus	—	10	—	—	—	—	10	—	10	6	—	—
troscheli	—	1	—	—	—	—	1	—	1	1	—	—
bleekeri	—	7	—	—	—	—	7	—	7	7	—	—
sordidus	—	14	—	—	—	—	14	—	14	5	—	—
bowersi	—	8	—	—	—	—	8	—	8	3	—	—
jonesi	—	15	1	—	—	1	15	—	16	2	—	—
capistratoides	—	11	—	—	—	—	11	—	11	8	—	—
dimidiatus	—	8	—	—	—	—	8	—	8	8	—	—
globiceps	—	6	—	—	—	—	6	—	6	1	—	—
brevifilis	—	10	—	—	—	—	10	—	10	10	—	—
singaporensis	—	8	—	—	—	—	8	—	8	8	—	—
atropectoralis	—	2	—	—	—	—	2	—	2	2	—	—
lepidus	—	3	6	—	—	6	3	—	9	1	3	—
fasciatus	—	5	2	—	—	2	5	—	7	5	2	—
vermiculatus	—	10	—	—	—	—	10	—	10	6	—	—
frenatus	—	1	—	—	—	—	1	—	1	1	—	—
janthochir	—	10	—	—	—	—	10	—	10	10	—	—
ghobban	—	8	—	—	—	—	8	—	8	8	—	—
chlorodon	—	8	—	—	—	—	8	—	8	7	—	—
marshalli	—	1	—	—	—	—	1	—	1	1	—	—

See footnotes at end of table.

TABLE 1.—*Number of vertebrae recorded from radiographs of genera and species of Scaridae*—Continued

Genera and species	Abdominal vertebrae [1]				Caudal vertebrae [2]				Total vertebrae	From anteriorly, the abdominal vertebrae on which a rudimentary haemal spine occurred		
	9	10	11	12	13	14	15	16	25	10	11	12
Scarus—Continued												
azureus	—	3	—	—	—	—	3	—	3	2	—	—
noyesi	—	5	—	—	—	—	5	—	5	4	—	—
californiensis	—	2	—	—	—	—	2	—	2	1	—	—
scaber	—	19	—	—	—	—	19	—	19	12	—	—
oviceps	—	8	—	—	—	—	8	—	8	2	—	—
niger	—	8	4	—	—	4	8	—	12	8	—	—
blochi	—	11	—	—	—	—	11	—	11	11	—	—
aeruginosus	—	10	—	—	—	—	10	—	10	—	—	—
randalli	—	15	—	—	—	—	15	—	15	11	—	—
pectoralis	—	4	4	—	—	4	4	—	8	3	2	—
dussumieri	—	7	—	—	—	—	7	—	7	7	—	—
vetula	—	—	7	—	—	7	—	—	7	—	3	—
guacamaia	—	6	—	—	—	—	6	—	6	—	—	—
coelestinus	—	—	7	—	—	7	—	—	7	—	6	—
coeruleus	—	2	8	—	—	8	2	—	10	2	2	—
croicensis	—	—	7	—	—	7	—	—	7	—	2	—
hoefleri	—	2	—	—	—	—	2	—	2	2	—	—
Scaridea												
zonarcha	4	—	—	—	—	—	—	4	4	—	—	—
Sparisoma												
radians	21	—	—	—	—	—	—	21	21	—	—	—
viridis	5	—	—	—	—	—	—	5	5	—	—	—
aurofrenatum	19	—	—	—	—	—	—	19	19	—	—	—
axillaris	7	—	—	—	—	—	—	7	7	—	—	—
rubripinnis	10	—	—	—	—	—	—	10	10	—	—	—
chrysopterum	37	—	—	—	—	—	—	37	37	—	—	—
abilgaardi	11	—	—	—	—	—	—	11	11	—	—	—
Calotomus												
spinidens	9	—	—	—	—	—	—	9	9	—	—	—
japonicus	15	—	—	—	—	—	—	15	15	—	—	—
Leptoscarus												
vaigiensis	8	—	—	—	—	—	—	8	8	—	—	—
Cryptotomus												
roseus	17	—	—	—	—	—	—	17	17	—	—	—
Nicholsina												
ustus	13	—	—	—	—	—	—	13	13	—	—	—
denticulatus	20	—	—	—	—	—	—	20	20	—	—	—
Euscarus												
cretensis	7	—	—	—	—	—	—	7	7	—	—	—
strigatus	1	—	—	—	—	—	—	1	1	—	—	—

[1] Abdominal vertebrae lack the haemal spine, or a rudiment may occur on the last vertebra; this rudiment does not reach past the next posterior vertebra.

[2] The first caudal vertebra is the one on which the haemal spine reaches to or beyond tips of first anal pterygiophores.

Probable phylogeny of scarid fishes

It is probable that the labrid and scarid fishes were derived from common ancestral stock, that the scarids separated from that labrid stock very early, and that *Cryptotomus* represents the most labridlike genus of the scarids living today, because of its labridlike teeth at the front of the jaws. These teeth slant forward and the head is more acutely angled than in other scarids. However, in *Cryptotomus* the pharyngeal mill is fully developed, placing it with the scarids. Since *Cryptotomus* and *Nicholsina* are more labridlike than other scarids and since these two genera have three rows of teeth on each upper pharyngeal bone, it is assumed that three such rows represents the more primitive condition and that any reduction in number of rows represents a more specialized condition.

The anatomical characters considered most important to the phylogeny of the Scaridae are (1) number of rows of pharyngeal teeth on each upper pharyngeal bone, (2) presence or absence and nature of incisorlike external teeth on dental plates, (3) overlapping of jaws at tips, (4) number of median predorsal scales, (5) number of rows of scales on cheek, (6) number of branched pectoral fin rays. In considering the evolutionary history of the genera of scarid fishes, one must decide what is the most primitive nature of each of these characters.

The upper pharyngeal bones are paired, each having three rows of teeth, or a reduced number of rows (see pls. 1–5). In every species examined the reduction occurs on the outside row, this outer row being rudimentary. It is concluded, therefore, that three fully developed rows of teeth on each bone represents the most primitive condition, whereas the most specialized condition occurs when only one row is present, as in *Scarops*.

2. The presence of incisorlike teeth, slanting forward at the front of the jaws in *Cryptotomus* much like those of labrid fishes, indicates a relationship with the family Labridae. The reduction of these incisorlike teeth to an imbricate pattern externally on the dental plate in *Calotomus*, and their complete absence on such genera as *Scarus* and *Sparisoma*, indicates the most primitive condition as occurring in *Cryptotomus*.

3. In labrid fishes generally, the enlarged incisorlike teeth at the front of the jaws slant forward, a condition much like that observed in *Cryptotomus*. In *Nicholsina* the lower teeth curve more abruptly toward the upper teeth than the upper curve toward the lower teeth. Usually a dental plate occurs inside these external teeth. Apparently very early in the phylogeny of scarid fishes two very major divisions arose, in one of which, the Sparisomatinae, the dental plate of the lower jaw closes over the edge of the dental plate of upper jaw. In the other phyletic line Scarinae, the dental plate of the upper jaw closes over the edge of the dental plate of the lower jaw. Thus it appears that the primitive condition obtains when the dental plates and teeth directly oppose each other or slant far forward.

4. The conclusions reached with regard to the first three characters indicate that with specialization the number of rows of teeth are reduced on the pharyngeals, the incisorlike teeth are lost, and a fused dental plate becomes the functional biting mechanism. It is assumed that the function of feeding is of greater importance to parrotfishes than such characters as number of scales on the head or number of pectoral rays. This leads to the conclusion that the number of median predorsal scales could vary widely among species of parrotfishes without greatly affecting the survival of the various species. It was

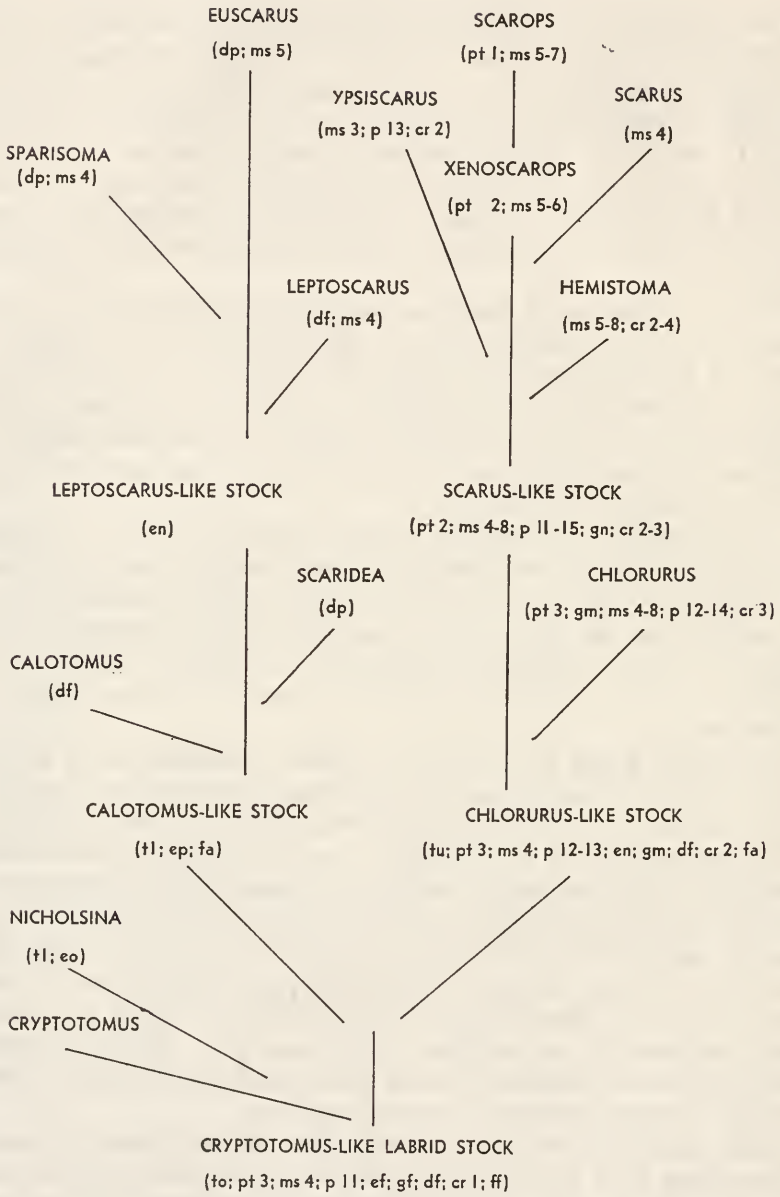


FIGURE 1.—Presumed phylogeny of scarid fishes:

cr 1,	cheek scale rows 1
cr 2–4,	cheek scale rows 2 to 4
df,	dorsal spines flexible
dp,	dorsal spines pungent
ef,	external teeth project obliquely forward
eo,	external teeth oppose those of opposite jaw
en,	no external imbricate teeth on jaws
ep,	external imbricate-like teeth present
fa,	gill membranes without free fold

observed that in the Sparisomatinae, the number of median predorsal scales are constantly 4 or 5, whereas in the Scarinae the number is variably 3 to 8. This variability appears to progress in two directions, reduction to 3 in *Ypsiscarus* and an increase to as many as 8 in certain species of the subgenus *Hemistoma*.

5. The number of rows of scales on the cheek in the Sparisomatinae is constantly one, whereas in the Scarinae it is variable from 2 to 4. It would appear that the median predorsal scales number 4 and that a single row of scales on the cheek represent the more generalized condition in scarid fishes. An increase in the number of rows of scales on the cheek appears to represent a specialized trend in the genus *Scarus*.

6. The branched pectoral fin rays in the Sparisomatinae number 11, whereas in the Scarinae they are normally 12 to 15. It would appear from the variability in number of these rays in the Scarinae that they are of lesser evolutionary importance, but the general direction of specialization indicates an increase in the number of branched pectoral rays. In the genus *Scarus* an increase in the number of pectoral rays agrees generally with the increase in number of scales in the ventral row on the cheek. This suggests a more specialized condition for those species with increased numbers.

In figure 1, each character given under the "*Cryptotomus*-like labrid stock" occurs in all ancestral stocks of the genus, up through each phyletic line unless differently indicated under each stock or genus. For example "pt. 3" (upper pharyngeal teeth in three rows) occurs for all "stocks" and genera through the *Scarus*-like phyletic lines but is gradually reduced to "pt. 1" (upper pharyngeal teeth in one row) in *Scarops* at the end of this phyletic line.

Geographical distribution

So much misidentification is prevalent for parrotfishes in the ichthyological literature that at present the geographical distribution of each species of parrotfish cannot be worked out in detail. Many

FIGURE 1.—Continued

ff,	gill membranes with free fold across isthmus	pt 1,	upper pharyngeal teeth in one row
gf,	gill rakers few and coarse	pt 2,	upper pharyngeal teeth in two rows
gm,	gill rakers several, moderately coarse	pt 3,	upper pharyngeal teeth in three rows
gn,	gill rakers very numerous, fine	tl,	tip of lower jaw fits over that of upper jaw
ms 4,	median predorsal scales 4	to,	tips of jaws oppose each other
ms 3–9,	median predorsal scales, 3, 4, 5, etc.	tu,	tip of upper jaw fits over that of lower jaw
p. 11,	branched pectoral rays 11		
p. 12–17,	branched pectoral rays 12 to 17		

species appear to have a wide distribution, whereas others appear to occur only in a restricted faunal subregion; but more collecting in numerous island groups will be required, along with careful identifications, before the distribution of individual species is determined. However, I believe a summary of present knowledge of distribution from the generic aspect is of value. Because most identifications were not trustworthy, I have not used the distribution records of scientific names in the literature except where a figure was given or where specimens cited were examined by me.

The major tropical geographic regions recognized in this discussion are: (1) Central and West Pacific, (2) Hawaiian and Johnston Islands; (3) East Pacific (the region adjacent to the Americas, including off-shore islands); (4) West Atlantic and Bermuda; (5) East Atlantic; (6) Indian Ocean, Andamans, and Ceylon.

Five genera (*Scarops*, *Chlorurus*, *Scaridea*, *Calotomus*, and *Leptoscarus*) are found only in the tropical Pacific and Indian Oceans, whereas three genera (*Sparisoma*, *Cryptotomus*, and *Euscarus*) occur only in the tropical Atlantic. Two genera (*Scarus* and *Nicholsina*) are common to the West Atlantic and East Pacific in the tropics.

Scarops has one subgenus, *Scarops*, that occurs in the tropical Pacific and Indian Oceans, and another, *Xenoscarops*, that is confined to the East Pacific. *Chlorurus* with 4 species ranges in the Central and West Pacific and the Indian Ocean.

Scarus, with 57 species, was subdivided into 3 subgenera. The subgenus *Ypsiscarus* with one species occurs in the West Pacific. The subgenus *Scarus*, with 22 species, has two species restricted to the western Indian Ocean and two to the Hawaiian Islands region; the remainder range in the Indian Ocean, the Central-West Pacific, and the Hawaiian Islands.

The subgenus *Hemistoma*, with 34 species, has 5 restricted to the western Indian Ocean; 3 restricted to the East Pacific, 6 in the Atlantic, one of which is restricted to the East Atlantic, and the remaining 20 in the Central and West Pacific and the Indian Ocean, only one of these ranging into the Hawaiian Islands. *Scaridea*, with one species, is known only from the Hawaiian Islands. The genus *Sparisoma*, with 7 species, occurs only in the Atlantic. *Calotomus*, with 2 species, occurs only in the Indian and Pacific Oceans, one species reaching the Hawaiian Islands and the other the West Pacific. *Leptoscarus*, with one species, occurs only in the Indian Ocean and the Central and West Pacific. *Cryptotomus* with one species is confined to Bermuda and the West Atlantic. *Nicholsina*, with 2 species, has one restricted to the West Atlantic, the other to the

East Pacific. *Euscarus*, with 2 species, is confined to the East Atlantic.

Though many of the various genera and species of parrotfishes recognized in this paper are of wide distribution, enough have been found restricted to certain geographical areas to indicate endemism at the species level, but less so at the generic level. Especially noteworthy regions of endemism are the western Indian Ocean, the Hawaiian and Johnston Islands, the East Pacific, the West Atlantic, and the East Atlantic.

These geographical regions may be considered by some zoogeographers as being regions of considerable endemism at the species level. That this is partly true I fully agree, but great caution is urged because at this state of our knowledge little research has been done to find out the similarities of species between the various regions. For example *Scarus azureus* of the East Pacific is close to *S. dussumieri* of the Central and West Pacific; *S. noyesi* (East Pacific) is very close to *S. ghobban* (Indo-Pacific); *Scarops jordani* occurs in the East Pacific and Hawaiian Islands.

During my search of the literature on parrotfishes I have found 354 scientific names proposed for species of the Scaridae. Among these, I am able to verify only 63 valid species in the tropical Indo-Pacific Ocean and only 17 for the tropical Atlantic Ocean, making a total of 80 species for the world. There may of course, be others. This study must not be considered final; some of the species are recognized only tentatively pending an extensive study of fresh specimens, a study which should clarify my treatment of several doubtful species.

I consider the following 34 scientific names as not identifiable:

Pseudoscarus arabicus Steindachner 1907
Scarus arcuatus Cuvier and Valenciennes 1839
Pseudoscarus augustinus Kossmann and Räuber 1876
Scarus caerulescens Cuvier and Valenciennes 1839
Scarus capistratus Kuhl and Von Hasselt *in* Cuvier and Valenciennes 1839
Scarus chloris Bloch and Schneider 1801
Scarus cretensis Bloch, pl. 220, 1790
Scarus cruentatus Cuvier and Valenciennes 1839
Scarus denticulatus Lacépède 1803
Scarus enneacanthus Lacépède 1803
Scarus ferrugineus Forskål 1775
Scarus festivus Cuvier and Valenciennes 1839
Scarus flavescens Bloch and Schneider 1801
Scarus flavescens Cuvier and Valenciennes 1839
Scarus frontalis Cuvier and Valenciennes 1839

396816—58——2

Scarus humeralis Poey 1861
Pseudoscarus ismaillius Kossman and Räuber 1876
Pseudoscarus labiosus Macleay 1883
Scarus lunulatus Cuvier and Valenciennes 1839
Pseudoscarus maculiceps Peters 1876
Scarus makaravar Thiolliere in Montrouzies 1856
Scarus mertensii Cuvier and Valenciennes 1839
Pseudoscarus moresbyensis Macleay 1883
Scarus nigrans Cuvier and Valenciennes 1839
Pseudoscarus papuensis Macleay 1883
Scarus prasiognathos Cuvier and Valenciennes 1839
Scarus quadrispinosus Cuvier and Valenciennes 1839
Scarus roseiceps Cuvier and Valenciennes 1839
Scarus russclei Cuvier and Valenciennes 1839
Scarus sexvittatus Rüppell 1835
Scarus spilurus Cuvier and Valenciennes 1839
Scarus toshi Whitley 1933
Scarus trispinosus Cuvier and Valenciennes 1839
Scarus viridis Bloch 1786.

The problem of homonyms is summarized as follows (no new names are proposed because there are available sufficient valid names):

aracanga: Scarus aracanga Günther 1862 (p. 209) and *Pseudoscarus aracanga* Günther 1862 (p. 227) are herein referred as synonyms of *Scarus croicensis.*

bennetti: Scarus bennetti Cuvier and Valenciennes 1839 is a synonym of *Scarus dubius* Bennett 1829, and a new name for *Scarus bennetti* Jordan and Evermann 1905 is not needed, since the latter is a synonym of *Scarus aeruginosus* Cuvier and Valenciennes 1839.

bleekeri: Callyodontichthys bleekeri Steindachner 1863 is referrable to the genus *Sparisoma,* and *Callyodon bleekeri* Weber and de Beaufort 1940 belongs in the genus *Scarus.*

cretensis: Scarus cretensis Bloch 1790 (pl. 220) is not identifiable. *Labrus cretensis* Linnaeus 1758 has been used as *Scarus cretensis* by authors; in this paper I use the name *Euscarus cretensis* (Linnaeus).

denticulatus: Scarus denticulatus Lacépède 1803, I do not consider identifiable. *Xenoscarus denticulatus* Evermann and Radcliffe 1917 is used in this paper under the name *Nicholsina denticulatus* (Evermann and Radcliffe).

dubius: Scarus dubius Bennett 1828 is a valid species. *Scarus dubius* Hildebrand 1946 was renamed *Scarus hildebrandi* Kanazawa 1952.

festivus: Scarus festivus Cuvier and Valenciennes 1839 is unidentifiable. *Scarus festivus* Longley *in* Longley and Hildebrand 1941 (nomen nudum) is referrable to *Sparisoma distinctum.*

flavescens: Scarus flavescens Bloch and Schneider 1801 is unidentifiable, as is *Scarus flavescens* Cuvier and Valenciennes 1839.

flavomarginatus: Scarus flavomarginatus Kner 1866 is a synonym of *Scarus niger* Forskål 1775. Since *Scarus flavomarginatus* Cuvier and Valenciennes 1839 is a synonym of *Scarus croicensis* Bloch 1790, no new name is needed.

frontalis: Scarus frontalis Cuvier and Valenciennes 1839 is unidentifiable. *Pseudoscarus frontalis* Macleay 1883 is a synonym of *Chlorurus gibbus* (Rüppell) 1828.

margaritus: Scarus margaritus Cartier 1874 is a synonym of *Scarus sordidus* Forskål 1775. Since *Callyodon margarita* Fowler 1917 is a synonym of *Scarus croicensis* Bloch 1790, no new name is needed.

mutabilis: Scarus mutabilis Lowe 1841 is a synonym of *Euscarus cretensis* (Linnaeus) 1758. Since *Scarus mutabilis* Gray 1854 is a synonym of *Scarus scaber* Cuvier and Valenciennes 1839, no new name is needed.

psittacus: Callyodon psittacus Gray 1854 is a synonym of *Sparisoma viridis* (Bonnaterre) 1788. *Scarus psittacus* Forskål 1775 is a synonym of *Scarus harid* Forskål 1775. *Coryphaena psittacus* Linnaeus 1758, sometimes used as a scarid name by authors, is a labrid from the Atlantic.

quoyi: Scarus quoyi Cuvier and Valenciennes 1839 is a synonym (in part) of *Scarus forsteri* Cuvier and Valenciennes 1839 and (in part) *Scarus blochi* Cuvier and Valenciennes 1839. *Scarus quoyi* Bleeker 1853 was renamed *Scarus bleekeri* (Weber and de Beaufort) 1940.

rostratus: Scarus rostratus Poey 1860 is a synonym of *Scarus coelestinus* Cuvier and Valenciennes 1839. *Pseudoscarus rostratus* Günther 1909 is a synonym of *Scarus lunula* (Snyder) 1908. *Scarus rostratus* Seale 1909 is a synonym of *Scarus sordidus* Forskål 1775.

spinidens: Scarus spinidens Quoy and Gaimard 1824 is a valid species in the genus *Calotomus*. *Scarus spinidens* Guichenut 1865 is the same as *Sparisoma axillaris* (Steindachner, 1878). Since this species already has a valid name, a new one is unnecessary.

viridis: Scarus viridis Bloch 1786 (on pl. 222) is unidentifiable. *Scarus viridis* Bonnaterre 1788 is valid as *Sparisoma viridis* (Bonnaterre) 1788. *Scarus viridis* Bleeker 1862 is a synonym of *Scarus blochi* Cuvier and Valenciennes 1839.

Dr. Howard E. Winn (Zoologica, New York Zool. Soc., vol. 40, pt. 3, pp. 145–147, pl. 1, 1955) describes a remarkable observation for parrotfishes in the vicinity of the Lerner Marine Laboratory, Bimini, British West Indies. After dark, he reports, certain parrotfishes form a large mucuous envelope that completely surrounds each fish. A small hole is present at the mouth, and another small opening occurs a little behind the caudal fin. These permit a flow of water past the gills.

Since publishing this interesting discovery, Dr. Winn has submitted parrotfishes to me for identification. *Scarus croicensis* Bloch, *S. punctulatus* Cuvier and Valenciennes, and "*Pseudoscarus guacamaia*" (actually *Scarus guacamaia Cuvier*) were correctly identified. His identification of another species as *Sparisoma pachycephalum* Longley is doubtful, as that species was badly confused by Longley and also by Longley and Hildebrand. Their specimens of *S. pachycephalum* are *Sparisoma rubripinnis* (Cuvier and Valenciennes) and so are Winn's specimens. His "*Scarus brachiale*" (op. cit., p. 146) is a synonym of *Sparisoma chrysopterum* (Bloch and Schneider).

Dr. J. L. B. Smith (Rhodes Univ. Ichthy. Bull. No. 1, pp. 1–23, pls. 41–45, January 1956) has published a paper, "The parrot fishes of the family Callyodontidae of the Western Indian Ocean," in which he discusses the many problems involved in the study of parrot fishes. Dr. Smith states (pp. 1–3). "The majority of the species have virtually the same body shape, the same number and arrangement of scales, and the same number of rays in most fins. There are certain characters such as the number of predorsal scales, the number and nature of scale rows below the eye and the form and color of the teeth, which show variation in combination between species, and some but not all of these are reasonably constant within one species. Parrot fishes have two well developed sets of gill rakers on the outer arch, the normal outer and a similar inner series. In most species these are numerous, small and close-set, and counts of these gill rakers are not diagnostic, for in some at least the number of gill rakers increases with the age of the fish. In some cases, however, the rakers are larger and fewer, immediately distinctive and here regarded as of generic significance."

I agree with this statement as well as with the following: "All in all, these fishes in general present one of the most formidable problems for the systematist. Even intensive close study of both living and fresh material does not always make it clear what constitutes a valid species. The purely museum worker with only preserved material can scarcely hope to achieve very much.

"There is probably not a single work based on preserved material of the Parrot fishes whose list of synonymy is worth any great consideration. It is ludicrous to expend time and effort in attempting to deduce what species earlier workers really had, and to attempt to fit material into their utterly inadequate definitions . . . .

. . . "In attempting to fit numbers of Parrot fishes into existing species it became clear that adequate and accurate definition and portrayal of our material would be of far greater value than any names. In consequence every effort was made to prepare the fullest possible notes as well as sketches of the live colors and markings. . . . All fresh specimens were described and sketched on prepared outlines on the spot. Wherever possible color photographs were taken, but on the whole, these are of relatively less value than a rapid sketch made by an experienced worker on the spot. . . ."

The illustrations mentioned by Smith were made by Margaret M. Smith and are of the greatest value in the recognition of species of parrot fishes.

It is most unfortunate, however, that apparently Smith either ignored or made little effort to determine the validity of already

named species, and made no serious attempt to exchange specimens of parrotfishes with other institutions, even though invited to do so. He has, instead, followed an individual course of action, stating: "It is still a convention in taxonomy that a worker unable to examine an inaccessible type which has never been adequately described or figured, is expected to spare no efforts to obtain any information he may require from the keepers of that type, in order to justify the erection of a new species related to the type in question. This is pandering to inadequacy and inefficiency. . . .

". . . We have ourselves, found no less than forty-one species, eleven of which in all are described as new, in some cases not from any conviction that they have never been found before, but because no adequate description and figure exists."

Perhaps, had he expended more effort searching the literature and in discussing his views in correspondence with other ichthyologists, and especially had he exchanged specimens with the big museums of the world, Smith would have been able to recognize as already named practically all the species he has in consequence re-named. Furthermore, ignoring many of the rules of zoological nomenclature, he has found it necessary to establish several new genera, all of which I conclude are synonyms of already valid genera. The erection of these new genera is the result of an inadequate study of the generic relationships of parrotfishes. Smith had available only Western Indian Ocean parrotfishes, and this is too limited a basis on which to establish new genera or new species in a family of world-wide distribution in warm seas.

Family Scaridae

This family may be recognized by the following combination of characters: Teeth coalesced, forming two dental plates in each jaw, each pair separated at the middle by a suture; externally canines or incisorlike teeth present or absent; gill membranes broadly joined to the isthmus, with or without a free fold across isthmus; scales on cheek in 1 to 4 rows; median predorsal scales 3 to 8; lateral line follows contour of back to below rear edge of base of dorsal fin then drops 1 or 2 scale rows, continuing along midaxis of caudal peduncle, the number of pores being rather constantly 17 to 20 in dorsal lateral line and 5 to 7 in peduncular lateral line (the usual number of pores is 18 + 5 or 6); dorsal rays IX,10; anal III,9, the anal spines slender, the first one weakly developed; pectoral rays ii,11 to ii,15; branched caudal rays 6 + 5; fins naked, except that basal part of median fins may have a row of scales; upper pharyngeal bones paired, each

dentigerous surface with 1 to 3 rows of molarlike teeth; lower pharyngeal bone single, bearing rows of molarlike teeth; vertebrae always 25.

Since my studies indicate that certain characters are important in grouping parrotfishes into phyletic lines, it seems advisable to recognize certain of these groups of species as full genera and others as subgenera. The following key distinguishes the genera and subgenera recognized:

KEY TO THE GENERA AND SUBGENERA OF SCARIDAE

1*a*. Cheek with 2 to 4 (4 in one Atlantic species) rows of scales below eye (fig. 5), second row may be represented by one scale; teeth fully coalesced into a parrotlike beak, with median suture at symphysis of each jaw; edge of dental plate of lower jaw included in that of upper jaw when mouth is closed; pectoral rays normally ii,11 to ii,15; dentigerous surface of lower pharyngeals longer than broad; gill membranes broadly joined to isthmus without a free fold across isthmus. Subfamily SCARINAE.

2*a*. Each upper pharyngeal bone with a single enlarged row of teeth (see pl. 2), no rudimentary row along base of the enlarged row except on small specimens of *Xenoscarops;* gill rakers of first gill arch 6 to 21+21 to 38. (Indo-Pacific.) . . . . . **Scarops**, new genus

3*a*. Three rows of scales on cheek. (East, Central, and West Pacific.) **Scarops**, new subgenus

3*b*. Two rows of scales on cheek. (East Pacific.) **Xenoscarops**, new subgenus

2*b*. Each upper pharyngeal bone with two enlarged rows of teeth (see pl. 1), and along the outer base of the outer enlarged row occurs a rudimentary row; 3 rows of scales on cheek; gill rakers 4 to 9+11 to 15. (Indo-Pacific.) . . . . . Genus **Chlorurus** Swainson

2*c*. Each upper pharyngeal bone with a single enlarged row of teeth (see pl. 3), and along the outer base of this row occurs a rudimentary row; 2 to 4 rows of scales on the cheek; gill rakers 12 to 30+25 to 50. (Atlantic, Indo-Pacific.). . . . . Genus **Scarus** Forskål

4*a*. Median predorsal scales 3. (West Pacific.) **Ypsiscarus**, new subgenus

4*b*. Median predorsal scales 4. (Central and West Pacific, Indian Ocean.) Subgenus **Scarus** Forskål

4*c*. Median predorsal scales 5 to 8. (Atlantic, Pacific, Indian Ocean.) Subgenus **Hemistoma** Swainson

1*b*. Cheek below eye with 3 or 4 scales in a single row; front edge of dental plate of upper jaw included within that of lower jaw when mouth is closed, or edges of the dental plates oppose each other; teeth more or less coalesced into a parrotlike beak or some of the teeth making up edge of dental plate with free or almost free or distinct edges, or there may be present externally pointed incisorlike teeth more or less imbricated and in rows; pectoral fin rays ii,11; gill rakers coarse, 2 or 3+1+6 to 12, the raker at angle of arch may be difficult to distinguish from those on ventral part of arch; upper pharyngeal bones with 3 rows of teeth on each side (see pls. 4 and 5); dentigerous surface of lower pharyngeals broader than long. Subfamily SPARISOMATINAE.

5*a*. Median predorsal scales 4 (fig. 5).

6*a*. Gill membranes broadly joined to isthmus, without a free fold across isthmus.

7*a*. Dorsal spines pungent.

8*a*. Free, imbricate, incisorlike teeth present externally on both jaws; inner lip not free at symphysis. (Hawaiian Islands.)

Genus **Scaridea** Jenkins

8*b*. No free, imbricate incisorlike teeth present externally on lower jaw, teeth coalesced into a beak much as in the Scarinae, but edges of the dental plates have more distinct but fused teeth; when mouth is closed edge of dental plate of upper jaw included within that of lower jaw; inner lip free across snout; anterior nasal opening with a cirrus, multifid at tip; canine teeth usually present on upper jaw. (Atlantic.)

Genus **Sparisoma** Swainson

7*b*. Dorsal spines flexible.

9*a*. Free, imbricate, incisorlike teeth present externally on both jaws; 6 or 7 teeth in the middle rows of lower pharyngeals, the seventh or outer tooth usually rudimentary; inner upper lip not free across symphysis of snout; upper jaw with canines at sides hooked out and somewhat backward. (Central and West-Pacific, Indian Ocean). . . . Genus **Calotomus** Gilbert

9*b*. No free, imbricate, incisorlike teeth present externally on jaws; teeth coalesced into a plate with external canines on upper jaw of adult males, absent on young and absent on adult females; 6 teeth present in middle rows of lower pharyngeals, the outer one on one side or the other rudimentary; lower jaw fits over tips of teeth of upper jaw when mouth is closed. (West Pacific, Indian Ocean) . . . . . Genus **Leptoscarus** Swainson

6*b*. Gill membranes broadly joined to isthmus, with a free fold (sometimes very narrow) across isthmus; dorsal spines flexible; pointed, incisorlike teeth present externally on both jaws; canines on outside of upper jaw present or absent.

10*a*. Dermal cirrus absent on anterior nostril, edge mostly in the form of an elevated or raised rim; inner lip not free at front of snout; head notably pointed from lateral profile, angle between dorsal and ventral profiles about 40 to 50 degrees, snout profile may be slightly concave; external teeth slanting forward at front of both jaws, those of lower jaw more slanting; when mouth is closed tips of upper jaw meet teeth of lower jaw obliquely. (West Atlantic, Bermuda.) . . . . Genus **Cryptotomus** Cope

10*b*. Dermal cirrus on anterior nostril well developed but usually not reaching posterior nostril; inner lip free across tip of snout; head more rounded, becoming somewhat pointed in adults, angle between dorsal and ventral profiles about 70 to 80 degrees; tips of external teeth at front of mouth meeting, or those of lower jaw may be included; not notably oblique. (West Atlantic, East Pacific.). . . . . Genus **Nicholsina** Fowler

5*b*. Median predorsal scales 5; gill membranes broadly joined to isthmus, without free fold; dorsal spines pungent; no free imbricated teeth present on jaws; edge of upper jaw included in that of lower jaw when mouth is closed. (East Atlantic.)

Genus **Euscarus** Jordan and Evermann

Subfamily Scarinae

This subfamily is characterized by having the teeth fully coalesced into plates with a median suture, and the tip of lower jaw enclosed in upper jaw when mouth is closed; rows of scales on the cheek number 2 to 4, ventral row may include one to several scales; upper pharyngeal bones with 1 to 3 rows of teeth, the outer or third row if present, rudimentary; lower pharyngeals with dentigerous surface notably longer than broad, with concave or flat surface; number of teeth in middle rows of lower pharyngeals 5, usually with outer tooth on one side reduced in size; if canines are present at side of jaws they are always behind middle of side of dental plate; anterior nostril without a dermal cirrus, or at most only a slightly raised rim; lateral line interrupted below rear end of base of dorsal fin, beginning again on second scale row below and extending along midbase of caudal peduncle; gill rakers on first gill arch vary from about 4 to 30 + 11 to 50; pectoral rays normally i,11 to ii,15; dorsal spines flexible; median predorsal scales 3 to 8; abdominal vertebrae 10 to 12 and caudal 13 to 15, always totaling 25.

Scarops, new genus and new subgenus

Genotype: *Scarus rubroviolaceous* Bleeker.

The characteristically colored species, *S. rubroviolaceous*, represents a distinct phyletic line previously referred to the catchall genus *Scarus*. The single row of teeth on each upper pharyngeal bone distinguishes *Scarops* from the other two closely related genera, *Scarus* and *Chlorurus*, in the subfamily Scarinae. So far only 3 species are referable to *Scarops*.

Parra in 1787 (Descripción . . . de Historia Natural . . ., p. 54, pl. 26) figured a parrotfish that he called guacamaya. He shows a single row of teeth on each upper pharyngeal bone. If he did not overlook the outer rudimentary row (which he probably did) this indicates that the genus may be represented in the Western Atlantic, but so far I have not yet located a specimen from that locality. *Scarus guacamaia* Cuvier with two rows of teeth on each upper pharygeal bone belongs to the genus *Scarus* and is different from that figured by Parra.

The two species so far referred to the subgenus *Scarops* have the following characters in common: The lower pharyngeal plate has a concave dental surface notably longer than broad, and the teeth number 5 in each row; the gill rakers vary from 6 to 21 + 21 to 38; and there are 3 rows of scales on the cheek and 6 or 7 median predorsal scales.

KEY TO THE SPECIES OF THE GENUS SCAROPS

1*a*. Three rows of scales on the cheek, the third, or ventral, row with 1 or 2 scales, *Scarops*, new subgenus.

2*a*. Background color brownish or reddish when alive, nearly each scale dorsolaterally has one or more short blackish or brownish lengthwise streaks; teeth white (pink when alive); lips separated by an angle of 50 to 80 degrees; pectoral rays usually ii,13; plate 6,A. (Hawaiian Islands, central West Pacific, Indian Ocean.) **rubroviolaceus** Bleeker

2*b*. General color blue or green, sides pink or light orange, except greenish below dorsal base and caudal peduncle green; margin of upper lip pale or orange, that of lower lip green; snout and most of head green except under side orange, with green crossbands on chin; teeth green, figure 2 and plate 6,B. (Hawaiian Islands and East Pacific.) **jordani** (Jenkins)

1*b*. Two rows of scales on the cheek, the second row with 4 to 6 scales; color dark olive green; fins dusky, teeth green in adult; figure 3. *Xenoscarops*, new subgenus. (East Pacific.) . . . . **perrico** (Jordan and Gilbert)

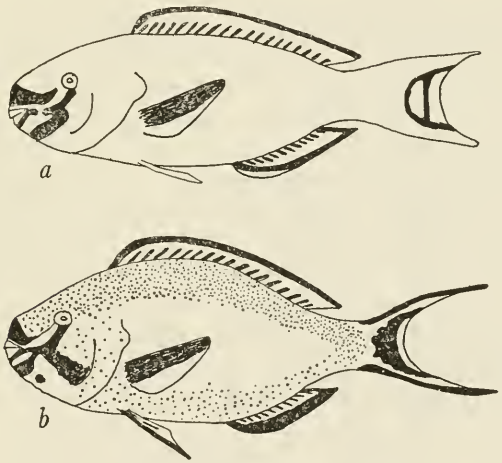


FIGURE 2.—*Scarops jordani: a*, 275-mm.-long specimen (probably a female) from Cocos Island, eastern Pacific collected by Halstead and Bunker; *b*, 465-mm.-long adult male. collected at Socorro Island, Revillagigedo Islands, Mexico, by Richard Rosenblatt. (Sketches by author.)

TABLE 2.—*Counts recorded for certain species of* Chlorurus *and* Scarops

Species	Median predorsal scales				Scale rows on cheek		Number of scales in each row on cheek																Number of pectoral fin rays		
							Dorsal row				Median row						Ventral row											
	4	5	6	7	2	3	5	6	7	8	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	ii, 12	ii, 13	ii, 14
Chlorurus																												
bicolor	—	—	2	13	—	15	1	12	4	1	—	4	10	4	—	—	—	—	—	—	4	4	8	1	1	25	3	—
gibbus	6	3	—	—	—	9	8	2	—	—	1	7	1	—	—	—	—	2	7	—	—	—	—	—	—	—	2	10
pulchellus	—	3	6	—	—	9	1	1	6	1	—	1	2	4	1	1	—	—	—	—	—	3	6	—	—	17	—	—
nigripinnis	—	—	1	1	—	4	—	2	2	—	—	—	2	2	—	—	—	—	4	—	—	—	—	—	—	4	—	—
Scarops (*Xenoscarops*)																												
perrico	—	22	3	—	34	—	30	4	—	—	5	24	3	—	—	—	34	—	—	—	—	—	—	—	—	37	2	—
Scarops (*Scarops*)																												
rubroviolaceous	—	—	12	1	—	13	1	12	1	—	—	1	9	4	—	—	—	1	13	—	—	—	—	—	—	3	20	2
jordani	—	—	6	—	—	9	1	8	—	—	—	—	7	2	—	—	—	—	8	—	—	—	—	—	—	1	11	—

Scarops, new subgenus

Scarops rubroviolaceus (Bleeker)

PLATES 3,D; 6,A

Scarus rubroviolaceus Bleeker, Verh. Bataviaasch Genootsch., vol. 22, p. 52, 1849 (type locality; Batavia).

Pseudoscarus rubroviolaceus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 37, pl. 13, fig. 3, 1862.

Scarus paluca Jenkins, Bull. U. S. Fish Comm., vol. 19 (1899), p. 60, fig. 18, 1900 (type locality; Hawaiian Islands).

Scarus catus Fowler, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 12, p. 542, pl. 21 lower fig. 1904 (type locality: Sumatra).

Callyodon ruberrimus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 316, fig. 56, 1906 (type locality: Pago Pago, Samoa; holotype, USNM 51749).

Callyodon rubroviolaceus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 11, pl. 43,J 1956 (Seychelles, Aldabra, Pemba, east coast of Africa south to lat. 14° S.).

This species is characterized by its general coloration of bright purplish red or dark brownish red, white teeth, orange eye, and red fins, except pectoral, which is bluish with a red streak dorsally, and dorsal, which is margined with dark blue distally. Nearly each scale dorsolaterally has one or more short blackish or brownish longitudinal streaks. The dark streaks remain visible on the scales after many years of alcoholic preservation. Usually 1 or 2 canines occur at the corner of the mouth in adults. There are 6 or 7 median predorsal scales, 3 rows of scales on the cheek, usually with 2 scales in the ventral row; pectoral fins usually with ii,13 rays.

I have studied specimens in lots from the following localities: China coast, 1 lot; Philippines and vicinity, 25; Celebes, 4; Borneo, 2; Ifaluk Atoll, 1; Kapingamarangi Atoll, 3; and Palmyra Island, 4.

Scarops jordani (Jenkins)

FIGURE 2; PLATES 2,C; 6,B

Pseudoscarus jordani Jenkins, Bull. U. S. Fish Comm., vol. 19 (1899), p. 63, fig. 21, 1900 (type locality: Hawaiian Islands).—Jordan and Evermann, Bull. U. S. Fish Comm., vol. 23 (1903), pt. 1, p. 358, fig. 158, pl. 44, 1905 (Hawaii).

Pseudoscarus heliotropinus Bryan, Occ. Pap. Bishop Mus., vol. 2, No. 4, p. 23, fig., 1906 (type locality: "Honolulu market").

This species is characterized by green teeth, ii,13 pectoral rays, usually 6 median predorsal scales, 3 rows of scales on the cheek, usually with 2 scales in the ventral (third) row. The general coloration is blue or green for the mature males and reddish brown for the females. Only large specimens of this species have been recorded and all of these have a humped snout. Small specimens are not known and the immature might be passing under some other named species.

Precision measurements were made on the 3 specimens from the East Pacific and are expressed in thousandths of the standard length, respectively. Standard lengths 275, 465, and 460. Length of head 360, 367, and 370; greatest depth 342, 410, and 370; length of snout 146, 177, and 176; diameter of eye 58, 43, and 41; fleshy interorbital space 131, 129, and 135; postorbital length of head 171, 183, and 182; least preorbital width 73, 85, and 91; least depth of caudal peduncle 138, 149, and 145; length of caudal peduncle 167, 184, and 165. Length of longest dorsal spine 127, 116, and 117; of soft dorsal ray 124, 131, and 137; of anal spine 135, 99, and 117; of soft anal ray 145, 114, and 119; of pectoral 244, 228, and 229; of pelvic 193, 205, and 187; of caudal fin 320, 485, and 327.

The lips do not cover the green teeth, the angle between them varies from 34 to 50 degrees; the inner lip is joined to upper lip much closer to snout tip than to corner of mouth; two canine teeth at rear corner of upper jaw; distal margin of caudal fin deeply concave.

Background coloration of specimens preserved in alcohol brownish, darker dorsally, paler ventrally. The details of color pattern are illustrated in figure 2 (p. 19); the green marks are represented by black shading.

The Soccoro Island specimen, which is a mature male, had the following color pattern when alive (based on a Kodachrome taken by Richard Rosenblatt, University of California at Los Angeles):
Edge of upper lip light orange, snout green, shading into dark brown posteriorly; edge of lower lip green, then an orange crossband, followed by an irregularly shaped green crossband; posterior to the latter on under side of head light orange; ventral part of pectoral fin pale, dorsally brownish green; outer margin of pelvic fin broadly green, inner half pale; distal half of anal fin green, basal half light orange; distal edge of dorsal with a narrow green band, basal ⅓ orange posteriorly, brown anteriorly; outer margin of caudal green, then submarginally pale, center rays of caudal green, except distal tips pale and basally pale. Dorsal part of body greenish with a reddish brown tinge anteriorly; side of body light orange, tinged with green ventrally.

At first I considered the specimens from the Eastern Pacific to represent a distinct species closely related to *S. jordani* but further study of a specimen caught by Richard Rosenblatt in full color indicates sexual dichromatism. The mature females are reddish brown, whereas the mature males predominate in greens.

The coloration of the Roqueta Island specimen was described as follows by Carl L. Hubbs in his field notebook: "Largely blue-green, becoming pale rosy brown on opercles, and on midsides. Teeth green. Edge of upper lip orange-yellow; snout deep blue-green above this border. Lower lip has a narrow blue border and then a broad band

of bright orange-yellow, then a broad blue one followed by irregular markings, not distinct, of dull orange-yellow. Dorsal fin blue forward with an increasing amount of orange-brown on membranes, until fin becomes brown with a definite narrow blue border. Caudal deep blue with a narrow, irregular brownish border. Anal blue, becoming brownish medially. Pectoral blue above, somewhat brown below."

I have studied 3 specimens (USNM 55499 to 55501) from the Hawaiian Islands and 3 from the Eastern Pacific, as follows: USNM 163664, Chatham Bay, Cocos Island, Dec. 26, 1952, collected by Bruce W. Halstead and N. C. Bunker, standard length 275 mm., viscera missing, sex not determined; USNM 163663, México, Guerrero, north side of Roqueto Island, Acapulco, collector C. L. Hubbs, *Zaca* Expedition, Sept. 3, 1946, standard length 460 mm., most of viscera missing, sex not determined; and a specimen loaned by the Univ. Calif. at Los Angeles, from Mexico, Revillagigedo Islands, Socorro Island, Binner's Cove, May 5, 1955, Richard Rosenblatt, standard length 465 mm., mature male.

Xenoscarops, new subgenus

Genotype: *Scarus perrico* Jordan and Gilbert

This new subgenus is intermediate between *Scarus* and *Scarops*. In *Scarus perrico* each upper pharyngeal bone in large adults have a single main row, but small specimens, 210 mm. in standard length and shorter, have 2 or 3 small rudimentary teeth representing the outer row; this outer rudimentary row apparently disappears, for in large adults there is no trace of it. This species may represent the evolutionary link between *Scarus* and *Scarops*. It could be considered, perhaps a subgenus under *Scarus* almost as well as under *Scarops*.

From *Scarops*, which has 3 rows of scales on the cheek, this new subgenus may be distinguished by having only 2 rows of scales on the cheek.

Scarops perrico (Jordan and Gilbert)

Figure 3; Plate 2,a,b

Scarus perrico Jordan and Gilbert, Proc. U. S. Nat. Mus., vol. 4, p. 357, 1881 (type locality: Mazatlán; holotype USNM 28328).

Callyodon microps Osburn and Nichols, Bull. Amer. Mus. Nat. Hist., vol. 35, art. 16, p. 170, fig. 12, 1916 (type locality: Santa Catalina Island, Gulf of California, holotype USNM 87548).

Scarus dubius (not of Bennett) Hildebrand, U. S. Nat. Mus. Bull. 189, p. 351, fig. 72, 1946 (type locality: Lobos de Afuera Bay, Peru; holotype USNM 128113; paratypes USNM 128114 and 128115).

Scarus hildebrandi Kanazawa, Copeia, No. 3, p. 203, 1952 (new name to replace *Scarus dubius* Hildebrand, preoccupied by *Scarus dubius* Bennett).

This species is characterized by having about 9 to 13 + 21 to 28 gill rakers; usually 5 median predorsal scales; in large specimens the forehead becomes enlarged and fleshy so that the first and second median anterior scales may become embedded; 2 rows of scales on the cheek; usually ii,12, rarely ii,13 pectoral rays; teeth probably green in adult and body with a plain dark olive green coloration. The young have 2 or 3 brown bars across under side of head, and the side

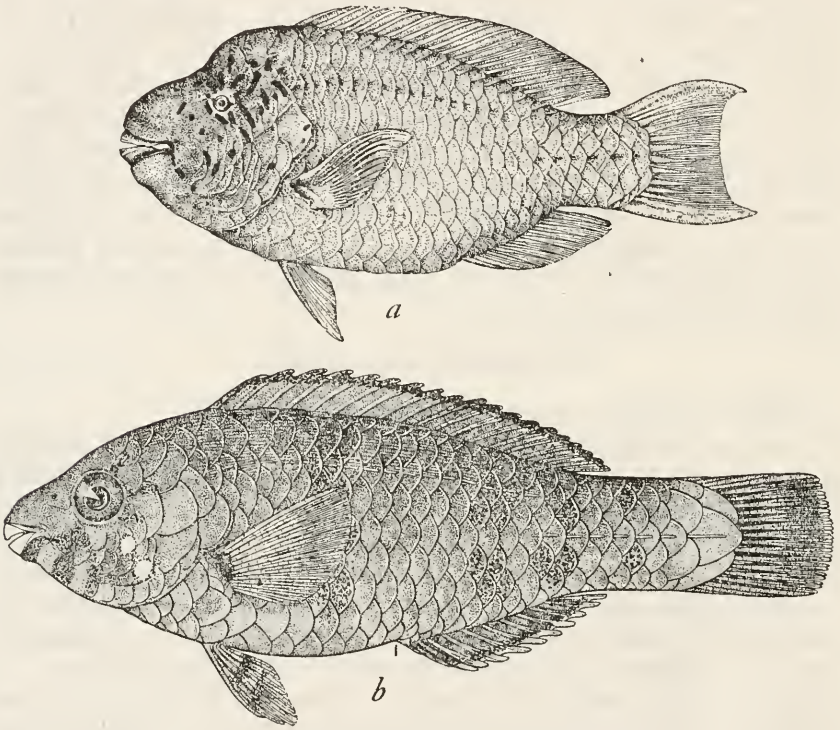


FIGURE 3.—*a*, Adult *Scarops perrico*, modified after Osborn and Nichols (=*Callyodon microps*, type) large adult, dark spots on head were green when alive; *b*, young after Hildebrand (=*Scarus hildebrandi* Kanazawa).

of body is indistinctly barred. The tail is rounded in young and becomes truncate or slightly forked in large adults. A specimen 430 mm in standard length (lent by Dr. Walker) has dark blue-green median fins, and green paired fins.

In addition to the types I have studied 4 lots from Panama, one from Chatham Bay, Cocos Island, and 6 from the Gulf of California, the latter loaned by Dr. Boyd Walker, University of California at Los Angeles.

Chlorurus Swainson

Chlorurus Swainson, Natural history and classification of fishes . . . , vol. 2, p. 227, 1839 (genotype, designated as *Scarus gibbus* Rüppell, pl. 20, fig. 2, by Swain, Proc. Acad. Nat. Sci. Philadelphia, p. 274, 1882); also as *Chloregaster* Swainson on p. 173 with no species listed).

Bolbometopon J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 8, 1956 (type species, *Scarus muricatus* Cuvier and Valenciennes = *Scarus gibbus* Rüppell).

Cetoscarus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 16, 1956 (type species, *Scarus pulchellus* Rüppell).

Rüppell (Atlas zu der Reise im Nördlichen Afrika . . . Fische des rothen Meers, p. 81, pl. 20, fig. 2, 1828) described *Scarus gibbus* from the Red Sea. It is very important to know what species was meant, since *S. gibbus* the only species listed is the genotype of *Chlorurus* Swainson. Rüppell's figure 2 shows a very characteristically shaped parrotfish with at least 3 rows of scales on the cheek and 15 pectoral fin rays, these being equivalent to my count of ii,14 rays. The angular profile of the head, especially the enlargement in front of the orbits, and the straight profile of the snout leaves no doubt in my mind that *gibbus* is what has been currently passing under the name of *Scarus muricatus* Cuvier and Valenciennes, as illustrated by them (Histoire naturelle des poissons, vol. 14, pl. 402, 1839). The two illustrations cited above are not accurate in regard to the arrangement and number of scales on the cheek. The immature in alcoholic preservation, up to a length of about 400 mm. in standard length have pale spots arranged in vertical rows; beginning at about 300 mm., these pale spots progressively disappear.

Dr. J. L. B. Smith, in supporting his proposed new genera for this group of species, did not attach sufficient importance to the "3 series of scales on the cheek" and gave undue importance to the naked preopercular "flange." Had he examined the pharyngeal mill of his specimens he would not have confused "*muricatus*" with "*microrhinus*."

Scarus gibbus Rüppell forms the basis of a very distinctive genus of parrotfishes characterized as follows: The upper pharyngeal bones have 3 rows of teeth on each side—two inner rows of large teeth and an outer rudimentary row along the base of the middle row; the lower pharyngeal plate has a concave dental surface as broad as long or a trifle longer than broad; the teeth number 5 in each row and the 3 inner teeth are elongate laterally about 3 times as broad as long; gill rakers on the first arch vary from 4 to 9 + 11 to 15 totaling 15 to 23; there are three rows of scales on the cheek and 4 to 7 median predorsal scales.

The following key distinguishes the four species now known to be referrable to this genus.

KEY TO THE SPECIES OF THE GENUS CHLORURUS

1*a*. Dorsal profile of snout straight, then profile bending abruptly over eyes and nearly straight again to dorsal fin origin; uniform brownish in color, except that young have pale spots; pectoral usually ii,14; 4 or 5 median predorsal scales. Forehead becomes greatly enlarged on specimens measuring 1½ feet and longer; plate 7. (West Pacific, Indian Ocean.) **gibbus** (Rüppell)

1*b*. Dorsal profile of head evenly arched from snout tip to dorsal origin; pectoral rays usually ii,12; median predorsal row of scales totaling 5 to 7.

2*a*. Four to eight scales in third or ventral row of cheek; young with a large black spot at front of dorsal fin and a broad black bar across head, leaving snout and mouth pale; adults with lower part of body below lateral line with black spots numbering from one to several on each scale, the number of spots increasing with size; when alive background coloration pinkish to reddish brown; plate 8,A–C. (Central and West Pacific, Indian Ocean.) . . . . . **bicolor** (Rüppell)

2*b*. One to three scales in third, or ventral row on cheek.

3*a*. No black spot on dorsal fin or black spots on scales; background coloration brownish, or green when alive, with red or pale spots on head above a line from mouth to pectoral base and pale spots on dorsoanterior parts of body; a green band (brown in alcohol) from below mouth, thence to below pectoral base to anus, bordered above and below by orange (pale in alcohol); plate 6,C. (Central and West Pacific, Indian Ocean.). . . . . **pulchellus** (Rüppell)

3*b*. A black spot may occur at front of dorsal fin or all median fins may be black, except anterior part of dorsal yellowish; some black spots may occur on scales of belly and breast; body and head yellowish; plate 6,D. (Zanzibar.) . . . **nigripinnis** (Playfair and Günther)

Chlorurus gibbus (Rüppell)

PLATES 1,A; 7

Scarus gibbus Rüppell, Atlas zu der Reise im nördlichen Afrika . . . Fische des rothen Meers, p. 81, pl. 20, fig. 2, 1828 (type locality: Red Sea).

Scarus muricatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 208, pl. 402, 1839 (type locality; Java.)

Pseudoscarus muricatus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 26, pl. 7, fig. 3, 1862.

? *Pseudoscarus frontalis* Macleay (not of Cuvier and Valenciennes), Proc. Linn. Soc. New South Wales, p. 590, 1883 (type locality: New Guinea).

? *Callyodon macleayi* Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 331, 1906 (new name for *Pseudoscarus frontalis* Macleay, preoccupied).

Callyodon shimoniensis J. L. B. Smith, Ann. Mag. Nat. Hist., ser. 12, vol. 6, p. 622, pls. 15, 16, 1953 (type locality: Kenya, Africa).

Chlorurus gibbus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 16, 1956 (Mohilla, Red Sea).

Bolbometopon muricatus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 8, plates 42H; 45A–D. 1956 (western Indian Ocean).

This species with white teeth is characterized by 4 or 5 median predorsal scales, 3 rows of scales on the cheek, with 1 or 2 scales in the ventral (third) row; and usually ii,14 pectoral rays. The snout

has a straight or slightly concave dorsal profile which bends abruptly over the eyes; the snout is longer than the postorbital part of the head; the coloration is uniform brown; young and halfgrown specimens have several white scales on the sides; large adults have a fleshy knob that develops on the forehead over the eyes.

I have studied one lot from the Dutch East Indies and 7 lots from the Philippines and vicinity.

Chlorurus bicolor (Rüppell)

PLATES 1,B; 8,A–C

Scarus bicolor Rüppell, Atlas zu der Reise im nördlichen Afrika . . . Fische des rothen Meers, p. 82, pl. 21, 1828 (type locality: Djedda).

Scarus ocellatus Cuvier and Valenciennes, Histoire naturelle des posissons, vol. 14, p. 278, 1839 (type locality: Carolines).

Callyodon scriptus (Gronow) Gray, Catalogue of fish collected and described by L. T. Gronow, p. 85, 1854 (type locality: Indies).

Pseudoscarus bicolor Bleeker, Atlas ichthyologique . . . , vol. 1, p. 33, pl. 14, 1862 (Celebes).

Scarus ophthalmistius Herre, Copeia, No. 1, p. 21, 1933 (type locality: Jolo, Philippine Islands).

Cetoscarus bicolor, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 17, pl. 44,C, D, E, 1956 (western Indian Ocean along East African coast to lat. 15° S.)

This species is characteristically colored at all sizes. The young have a dark ocellate spot at the front part of the dorsal fin and the larger fishes have black spots on the lower scales of the body. The median predorsal scales number 6 or 7; there are 3 rows of scales on the cheek, with 4 to 8 scales in the ventral (third) row; and there are usually ii,12 pectoral fin rays.

The lips mostly cover the teeth, the angle between them varying from 10 to 40 degrees; the inner lip of upper jaw joins the outer lip near the symphysis; canines are absent at the corner of the mouth in all sizes studied; the caudal fin varies from rounded in the young to truncate, with a strongly concave distal margin in the largest adult.

In alcohol, the background coloration of juveniles is whitish or pale, with a broad brownish bar on middle and rear ¾ of head, snout and jaws pale; this bar may fade in alcohol, leaving a blackish line marking its anterior and posterior edges; anteriorly the dark line extends in front of eyes, thence just behind rear of mouth to underside of head; the posterior dark line extends from just in front of the dorsal origin downward along rear of head across pectoral base on second scale row above base of pelvics; middle of spiny dorsal with a large black ocellate spot. In halfgrown and adults the black bar on the head begins to disappear at about 160 mm.; the black spots or bars begin to appear on the anteroventral scales at a length of about 125 mm. The background coloration of adults is pale dorsally, darker ventrally, the

abrupt change to dark background occurs on the scale row below anterior lateral line; anterior and posterior edges of scales with a blackish bar, and center of scales with one to three or more blackish spots; ventral part of head behind mouth black spotted; a row of black spots, one on each scale of anterior lateral line, occurs on its posterior half; pectoral pale; other fins dusky.

When alive, juveniles have a pinkish background coloration, with the bar on the head brick red; the iris is bright red, the distal margin of caudal fin has a red transverse band, the black spot on the spiny dorsal is bordered with orange, and the fins are light pinkish. Half-grown specimens have a background coloration that is pinkish dorsally and light purplish ventrally; the dorsal spot is purplish black bordered by orange; the caudal fin is reddish and the eye red; the pectoral and pelvic fins are reddish yellow; the anal is yellowish distally, its distal edge is margined with a gray streak, and basally it has reddish areas on the membranes between the rays; the distal edge of the orange dorsal fin is gray. Adults have a background coloration reddish brown dorsally and purplish brown ventrally; all fins brown except the pectoral, which is pinkish; the iris red; and on the scales blackish spots that may number as many as a dozen on largest adults.

I have studied specimens in lots from the following localities: Samoa, 1 lot; Marshall Islands, 14; Okinawa, 1; Philippines and vicinity, 17; Kapingamarangi Atoll, 2; Tuomotu Islands, 1; and Ifaluk Atoll, 11.

Chlorurus pulchellus (Rüppell)

PLATES 1,C; 6,C

Scarus pulchellus Rüppell, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig, Fische, p. 25, pl. 8, fig. 3, 1835 (type locality: Red Sea).

Pseudoscarus pulchellus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 34, pl. 10, fig. 3, 1862.

Cetoscarus pulchellus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 17, pl. 43,E, 1956 (East African coast south to lat. 14° S.).

This species is distinguished by its characteristic color pattern; the small number of gill rakers, about 6 or 7+12 to 15, totaling about 20 to 23; the three rows of teeth on each upper pharyngeal bone; the 3 rows of scales on the cheek, with 5 or 6 scales in the ventral (third) row; 5 or 6 median predorsal scales, and ii,12 pectoral fin rays. In adults the preorbital distance is contained about 2½ times in that of head.

The lips do not cover the white teeth and the angle between their edges is about 25 degrees; the inner and outer upper lips are fused so that only a rudiment of inner lip may occur near corner of mouth;

canine teeth are absent; distal margin of caudal fin deeply forked in adults; between eye and scales on cheek is a broad naked area.

The background coloration is bright green to purplish green; the pale spots on head and anterior part of body are red; posterior margin of each scale reddish; pectoral fin purple; a red or orange streak extends from corner of mouth to pectoral base and thence to anal fin origin, below which is a broad green band; under side of head and belly orange; eye orange; edge of upper lip orange, that of lower lip green; chin orange; outer edges of dorsal and anal fins bright blue-green; basal ¾ of anal fin orange; basal ⅕ of dorsal with orange membrane and bluish rays; outer edges of caudal blue; distal margin of caudal with a lunate orange band, basally a blue and green lunate band, the base orange; pelvics orange.

In the northern Marshalls this characteristic species was never seen over the intertidal zone of the reef, but it did occur in the deeper waters of the lagoon and along the deeper waters of the ocean side of the reefs. The smallest specimen seen by me was about a foot long.

I have studied specimens in lots from the following localities: Tuamotu Islands, 1 lot; Phoenix Islands, 1; Marshalls, 3; Celebes, 1; Raroia Atoll, 1; Kapingamarangi Atoll, 1; and Philippines, 6.

Chlorurus nigripinnis (Playfair and Günther)

PLATE 6,D

Pseudoscarus nigripinnis Playfair and Günther, Fishes of Zanzibar . . ., p. 105, pl. 15. fig. 2, 1866 (type locality: Zanzibar; types examined in British Museum, Cat. No. 1865.2.27.80, standard length 151 mm., Cat. No. 1866.1.19.16, standard length, 172 mm.).

This species is characterized by having 6 or 7 median predorsal scales, 3 rows of scales on cheek, with 2 scales in the ventral (third) row; ii,12 pectoral fin rays; and whitish teeth. In color pattern it is close to *C. bicolor* but differs in having black fins, except that front of dorsal is yellowish and the dark spots on the scales are limited to the breast. They differ chiefly in that *bicolor* has 4 or more scales in the ventral row on cheek whereas *nigripinnis* has only 2 scales. I have not seen a specimen of this species.

Scarus Forskål

Scarus Forskål, Descriptiones animalium . . . , p. 25, 1775 (genotype designated as *Scarus psittacus*[2] (not of Linnaeus) Forskål=*Scarus harid* Forskål by

[2] *Scarus psittacus* Forskål from the Red Sea is a different species than *Coryphaena psittacus* Linnaeus, a labrid from the Atlantic. Among parrotfishes *Scarus psittacus* Forskål has been confused with "*Scarus psittacus* (Linnaeus)."

Jordan and Gilbert, U. S. Nat. Mus. Bull. 16, p. 938, 1882; and by Swain, Proc. Acad. Nat. Sci. Philadelphia, p. 274, 1882).

Calliodon Walbaum, *in* Petri Artedi, Bibliotheca ichthyologica . . . , ed. 2, vol. 3, p. 649, 1792; Bloch and Schneider, Systema ichthyologia . . . , p. 312, 1801 (genotype designated as *Calliodon lineatus* Bloch and Schneider by Jordan and Gilbert, U. S. Nat. Mus. Bull. 16, p. 606, 1882; *Calliodon lineatus* Bloch and Schneider=*Scarus croicensis* Bloch.

Callyodon (Gronow) Scopoli, Introductio ad historiam naturalem . . . , p. 449, 1777; Gray, Catalogue of fish collected and described by L. T. Gronow, p. 83, 1854 (genotype designated by Jordan and Evermann, U. S. Nat. Mus. Bull. 47, vol. 2, p. 1642, 1898, as *Callyodon lineatus* Bloch and Schneider.

Petronason Swainson, Natural history and classification of fishes . . . , vol. 2, p. 226, 1839 (genotype designated as *Scarus psittacus* Rüppell, pl. 20, fig. 1, by Swain, Proc. Acad. Nat. Sci. Philadelphia, p. 274, 1882. *Scarus psittacus Ruppell*=*Scarus psittacus* Forskål).

Erychthys Swainson, Natural history and classification of fishes . . . , vol. 2, p. 226, 1839 (genotype designated as *Scarus croicensis* Bloch, pl. 221, by Swain, Proc. Acad. Nat. Sci. Philadelphia, p. 274, 1882).

Hemistoma Swainson, Natural history and classification of fishes . . . , vol. 2, p. 226, 1839 (genotype designated as *Scarus reticulata* Swainson=*Scarus pepo* Bennett=*S. ghobban* Forskal by Swain, Proc. Acad. Nat. Sci. Philadelphia, p. 274, 1882; Jordan and Gilbert, U. S. Nat. Mus. Bull. 16, p. 606, 1882, also designated *S. pepo* Bennett as genotype.

Pseudoscarus Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 230, 1861 (genotype: *Scarus microrhinos* Bleeker).

Loro Jordan and Evermann, Rep. U. S. Comm. Fish. 1895, app. 5, p. 418, 1896 (genotype: *Scarus guacamaia* (not of Parra) Cuvier).

Xanothon J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 4, 1956 (type species, *Xanothon bipallidus* Smith).

Margaritodon J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 15, 1956 (type species; *Callyodon verweyi* Weber and de Beaufort).

Hipposcarus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 17, 1956 (type species: *Scarus harid* Forskål).

The genus *Scarus*, with *Scarus psittacus* Forskål as the genotype is characterized as follows: The two upper pharyngeal bones have two rows of teeth on each, the inner row composed of large teeth and the outer row of rudimentary teeth along the base of the main row; the lower pharyngeal plate has a concave dental surface about 1⅔ times longer than broad; the teeth number 5 in each row, the three inner teeth of each row twice as broad as long; gill rakers on first gill arch vary from 12 to 30+25 to 50, totaling about 39 to 80.

TABLE 3.—*Counts recorded for certain Indo-Pacific species of the Subgenera* Scarus *and* Ypsiscarus

Species	Median predorsal scales		Scale rows on cheek			Scales in each row on cheek																					Pectoral fin rays				
						Dorsal row						Median or second row									Ventral or third row											
	3	4	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	ii, 11	ii, 12	ii, 13	ii, 14	ii, 15
Ypsiscarus																																			
oedema	10	—	—	10	—	—	3	4	3	—	—	—	—	—	—	—	4	3	3	—	—	10	—	—	—	—	—	—	—	—	—	—	20	—	—
Scarus																																			
cyanescens	—	2	—	3	—	—	—	3	—	—	—	—	—	—	—	—	—	3	—	—	—	3	—	—	—	—	—	—	—	—	—	—	3	—	—
bowersi	—	7	—	7	—	—	2	5	—	—	—	—	—	—	—	—	—	5	2	—	—	7	—	—	—	—	—	—	—	—	—	—	14	—	—
capistratoides	—	8	—	8	—	—	5	4	—	—	—	—	—	—	—	—	—	3	4	2	—	9	—	—	—	—	—	—	—	—	—	1	14	—	—
sordidus	—	249	—	249	—	—	3	28	2	—	—	—	—	—	—	—	3	15	13	1	—	249	—	—	—	—	—	—	—	—	—	2	79	4	—
jonesi	—	156	—	156	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	156	—	—	—	—	—	—	—	—	—	3	115	5	—
troscheli	—	2	—	4	—	—	—	3	1	—	—	—	—	—	—	—	1	—	3	—	—	4	—	—	—	—	—	—	—	—	—	—	3	1	—
perspicillatus	—	21	3	18	—	—	10	12	1	—	—	3	10	6	4	—	—	—	—	—	—	23	—	—	—	—	—	—	—	—	—	—	24	—	—
venosus	—	15	—	15	—	—	2	14	—	—	—	—	—	—	—	—	5	10	1	—	—	16	—	—	—	—	—	—	—	—	—	30	—	—	—
taeniurus	—	70	—	70	—	—	3	4	—	—	—	—	—	—	—	—	1	6	—	—	—	70	—	—	—	—	—	—	—	—	8	99	2	—	—
forsteri	—	94	—	94	—	—	2	11	—	—	—	—	—	—	—	—	5	7	1	—	—	94	—	—	—	—	—	—	—	—	2	123	3	—	—
schlegeli	—	11	—	11	—	—	—	9	—	—	—	—	—	—	—	—	4	4	1	—	—	24	—	—	—	—	—	—	—	—	—	24	—	—	—
rhoduropterus	—	21	—	21	—	—	4	16	1	—	—	—	—	—	—	—	—	7	13	2	—	22	—	—	—	—	—	—	—	—	—	1	40	—	—
bleekeri	—	9	—	9	—	—	—	6	3	—	—	—	—	—	—	—	—	3	4	2	—	9	—	—	—	—	—	—	—	—	—	—	18	—	—
microrhinos	—	72	—	—	72	—	12	27	1	—	—	—	—	—	—	—	2	11	20	7	—	—	—	—	1	3	10	8	18	1	—	—	1	68	6
harid	—	38	—	—	40	—	—	13	13	2	3	—	—	—	—	—	3	14	9	4	1	—	—	—	6	16	12	1	—	—	—	2	60	4	—
javanicus	—	35	—	—	35	—	7	7	1	—	—	—	—	—	—	—	1	13	1	—	—	—	14	2	—	—	—	—	—	—	—	22	—	—	—
formosus	—	12	—	—	12	—	4	9	—	—	—	—	—	—	—	—	4	8	1	—	—	—	3	12	—	—	—	—	—	—	—	16	—	—	—
*lunula**	—	7	—	—	7	—	—	6	1	—	—	—	—	—	—	—	—	4	3	—	—	—	—	5	2	—	—	—	—	—	—	21	—	—	—
lauia	—	2	—	—	2	—	—	2	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2	—	—	—	—	—	—	—	3	1	—	—
dubius	—	42	—	11	32	1	17	25	1	—	—	—	—	—	—	—	16	24	4	—	—	11	33	—	—	—	—	—	—	—	—	61	1	—	—
flavipectoralis	—	1	—	—	2	—	1	1	—	—	—	—	—	—	—	—	2	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	—	—	—

*Usually a pair of scales in front of first median predorsal scale.

TABLE 4.—*Counts recorded for certain Indo-Pacific species of the subgenus* Hemistoma *Swainson of the genus* Scarus

Species	Median predorsal scales				Scale rows on cheek	Scales in each row on cheek														Pectoral fin rays			
						Dorsal row				Median row					Ventral row								
	5	6	7	8	3	5	6	7	8	5	6	7	8	9	1	2	3	4	5	6	ii,11	ii,12	ii,13	ii,14
aeruginosus	36	18	—	—	78	3	20	4	—	2	14	9	2	—	3	7	15	—	—	—	2	90	10	—
lepidus	1	29	1	—	24	—	9	10	—	—	1	10	7	2	—	3	7	6	2	2	—	40	2	—
globiceps	4	11	—	—	15	2	12	2	—	1	7	7	1	—	2	4	9	1	—	—	—	24	—	—
vermiculatus	—	1	8	—	9	—	5	3	1	—	—	6	2	1	—	—	8	1	—	—	—	18	—	—
scaber	3	8	—	—	9	—	5	4	—	—	2	6	1	—	—	3	8	—	—	—	2	17	—	—
oviceps	1	5	2	—	7	—	2	7	—	—	2	3	4	—	—	—	9	4	—	—	—	21	—	—
pectoralis	—	11	3	—	15	—	3	10	2	—	1	8	5	1	—	—	10	11	1	—	—	28	1	—
dussumieri	—	14	—	—	14	—	8	—	—	—	8	—	—	—	4	3	—	—	—	—	5	20	5	—
dimidiatus	—	12	—	—	12	1	4	5	—	—	2	7	2	1	—	1	8	1	—	—	—	22	—	—
niger	—	1	8	1	9	—	1	9	1	—	—	6	3	1	—	—	2	7	5	—	1	26	—	—
*madagascarensis**	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	x	—	—
fasciatus	—	7	2	—	9	5	2	1	—	3	5	—	—	—	—	7	2	—	—	—	—	15	—	—
blochi	—	12	—	—	15	4	11	—	—	2	12	1	—	—	—	9	1	—	—	—	—	21	—	—
frenatus	—	2	—	—	2	1	1	—	—	—	1	1	—	—	—	1	1	—	—	—	—	4	—	—
randalli	—	5	5	—	10	—	6	3	1	—	2	7	1	—	—	1	9	—	—	—	—	20	—	—
chlorodon	—	12	2	—	15	—	11	4	—	—	7	5	3	—	4	7	4	—	—	—	—	4	24	1
marshalli	—	1	2	—	6	—	6	—	—	2	3	1	—	—	1	1	2	2	—	—	—	—	6	—
*rubrofasciatus**	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	x	—
*africanus**	x	—	—	—	x	—	—	x	—	—	x	x	—	—	—	x	—	—	—	—	—	—	x	—
ghobban	1	8	—	—	9	—	13	—	—	—	10	4	—	—	3	9	1	—	—	—	—	1	16	1
brevifilis	1	31	1	—	36	1	26	8	1	1	2	23	10	—	6	19	7	—	—	—	—	5	72	1
*guttatus**	—	x	x	—	x	—	x	x	—	—	x	x	—	—	x	x	x	—	—	—	—	—	x	x
singaporensis	1	16	—	—	17	3	12	3	—	2	9	6	1	—	1	11	6	—	—	—	—	—	30	—
atropectoralis	—	2	—	—	2	—	2	2	—	—	1	2	1	—	—	4	—	—	—	—	—	—	4	—
janthochir	—	3	—	—	5	1	4	—	—	—	—	4	1	—	—	1	4	—	—	—	—	—	6	—
noyesi	—	6	—	—	12	—	12	—	—	—	10	2	—	—	—	12	—	—	—	—	—	—	12	—
californiensis	1	2	—	—	6	—	6	—	—	1	3	2	—	—	—	3	2	—	—	—	—	—	6	—
azureus	1	3	—	—	8	—	7	1	—	—	7	1	—	—	2	5	1	—	—	—	—	—	8	—

*x counts from literature.

KEY TO THE SPECIES OF SCARUS OF THE TROPICAL PACIFIC AND INDIAN OCEANS

1*a*. Median predorsal scales 3; scale rows on cheek 2; pectoral rays ii,13; teeth pale; general background coloration in alcohol plain chocolate brown or blackish brown, when alive plain bluish black or plain purplish black; adults may have a ball-like swelling on forehead above eyes; plate 8,D. *Ypsiscarus*, new subgenus. (Philippines and Okinawa.)

oedema (Snyder)

1*b*. Median predorsal scales 4 to 9; figure 5,*b*.

2*a*. Median predorsal scales 4. Subgenus *Scarus*.

3*a*. Scale rows on cheek 3, ventral (third) row may be represented by 1 or more scales.

4*a*. Pectoral rays usually ii,13 to 15; third, or ventral, row of scales on cheek usually with 3 to 8 scales.

5*a*. Pectoral rays ii,14 or 15; ventral (third) row of scales on cheek usually with 4 to 8 scales; teeth not covered by lips, angle between lips 80 to 110 degrees; lower part of head, below a line from lower jaw to ventral part of pectoral base, abruptly pale or light brownish, the area dorsal to this is dark brownish; teeth gray, sometimes with a greenish tinge; when alive, lower part of head light greenish; edges of lips reddish, submarginally green; figure 4 and plate 9,A. (Central and West Pacific, Indian Ocean.) . . . . . **microrhinos** Bleeker

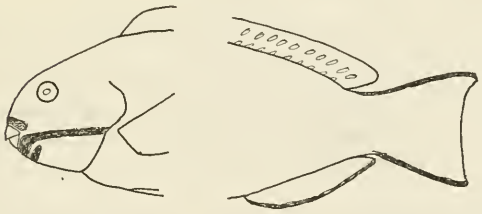


FIGURE 4.—*Scarus microrhinos*, color pattern of a specimen, 155 mm. in standard length. (Sketch by author.)

5*b*. Pectoral rays ii,13 rarely ii,14; ventral (third) row of scales on cheek with 3 to 5 scales; teeth usually covered by the lips; background coloration light brownish to grayish white, center of lower scales whitish; posterior edges brownish; preorbital space wide, the width contained about 2½ to 3⅓ times in head length, wider than in all other species with 4 median predorsal scales; figure 5 and plate 9,B. (Central and West Pacific, Indian Ocean . . . . . **harid** Forskål

4*b*. Pectoral rays usually ii,12; ventral (third) row of scales on cheek with 1 to 3 scales; teeth white or yellowish white.

6*a*. Dorsal edge of pectoral base with a blackish spot, which may be faded in long preserved specimens.

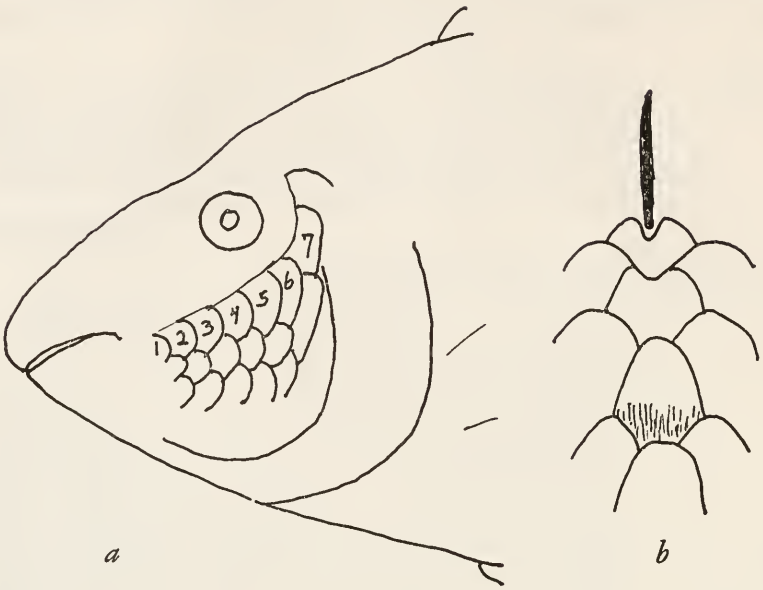


FIGURE 5.—*Scarus harid: a*, diagram illustrating how scales are arranged on cheek and how counted to opposite rear edge of preopercle; *b*, diagram illustrating the arrangement of 4 median predorsal scales. (Sketches by author.)

7*a*. Posterior half of body, beginning opposite anal origin, abruptly paler than anterior half.

8*a*. Anal fin with broad blue distal band, and basal half reddish brown; pale to orange or red streaks radiate from eye, one extending from below eye toward pectoral base; side of caudal peduncle green; plate 9,c. (West Pacific.) **javanicus** Bleeker

8*b*. Posterior half of body from below base of dorsal spines VIII or IX abruptly paler than dark anterior half of body; a brownish red band basally across anal fin, the rest of fin, including the narrow base, blue; side of caudal peduncle yellowish; a green band from snout past lower edge of eye to angle of opercle; plate 9,D. (West Pacific.) **flavipectoralis**, new species

7*b*. Body color all of same general intensity, not paler posteriorly; background coloration plain brownish or light reddish brown; in alcohol usually 2 or 3 light streaks ventrally on belly, one on each scale row; caudal and dorsal fin yellow; anal with a narrow blue edge, basally light reddish brown; no streaks radiating from eye; lips nearly cover whitish teeth; plate 10,A. (Hawaiian Islands; Central and West Pacific, Indian Ocean.) . . . . . **dubius** Bennett

6*b*. No black spot on base of pectoral fin.

9*a*. Anal fin with three color streaks.

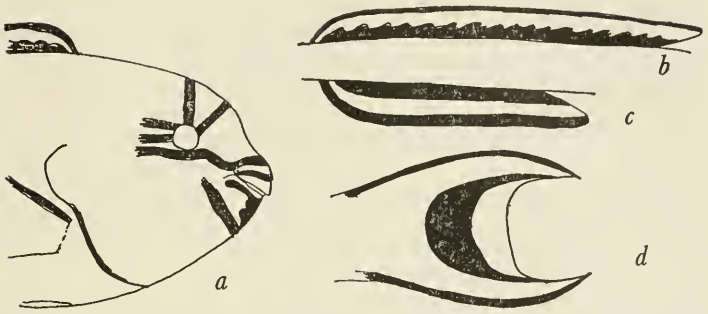


FIGURE 6.—*Scarus lunula*, green color markings in black; *a*, head; *b*, dorsal fin; *c*, anal fin; *d*, caudal fin. (Sketches by author.)

10*a*. Edge of upper lip blue or green, then submarginally pinkish or purplish red, thence from middle of snout a green streak extends past ventral margin of eye, disappearing behind eye, usually one or two other green streaks extend behind eye and one or two other green streaks extend from eye across interorbital space, figure 6 and plate 10,B. (Central and West Pacific.) . . . **lunula** (Snyder)

10*b*. No streaks or bars radiating from eye; snout plain yellowish green; a roundish pale spot on lower part of head about opposite eye; plate 10,C. (Central and West Pacific.) **formosus** Cuvier and Valenciennes

9*b*. Anal fin with two streaks, in addition there may be a series of spots basally; streaks on head as illustrated in figure 7. (Hawaiian Islands.) . . . . . **lauia** Jordan and Evermann

3*b*. Scale rows on cheek 2, second or "middle" row may be represented by 1 or more scales.

11*a*. Second, or "middle," row of scales on cheek with from 0 to 3 scales, (usually 0 on one side only) these scales may be embedded in the skin in large adults; pectoral rays ii,13 (see table 3).

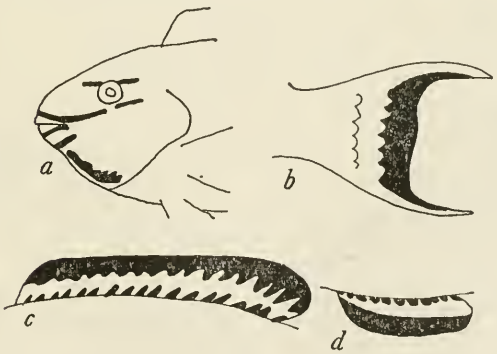


FIGURE 7.—*Scarus lauia*, green color markings in black: *a*, head; *b*, caudal fin; *c*, dorsal fin; *d*, anal fin. (Sketches by author from the types.)

12*a*. Coloration plain brownish, even at a length of 2 feet, except peduncular region and caudal fin are pale; no marks on head (females of *ahula=perspicillatus*); figure 21,*d*.

12*b*. Cheek and operculum with (in alcohol) pale, narrow irregularly shaped streaks or lines, bright blue-green when alive; figure 21,*a-c*. (Hawaiian and Johnston Islands.)

perspicillatus Steindachner

11*b*. Second row of scales on cheek with from 5 to 9 scales.

13*a*. Pectoral rays usually ii,12, occasionally ii,11 or ii,13 (see table 3); dorsal base of pectoral fin with a dark spot that persists in specimens preserved in alcohol.

14*a*. Side of body with a vertically pale bar that extends from front of soft dorsal to front of anal fin; anterior to this pale bar a dark bar set off by a pale area dorsally; sometimes this anterior pale bar is continuous anteriorly to cover dorsal half of head; dorsal area of pale bars bright yellowish when alive; for details of color streaks on head, see plate 10,D. (Central and West Pacific, Indian Ocean.)

schlegeli (Bleeker)

14*b*. Side of body with 4 or 5 alternating dark and pale bars, the pale bar about 2 scales wide, notably narrower than dark bar; lips nearly close, the angle between them usually narrower than 30 degrees; figure 22. (West Pacific.)

venosus Cuvier and Valenciennes

14*c*. Sides of body without distinct vertical bars.

15*a*. Coloration of body plain brownish, or nearly so.

16*a*. Dorsal and anal fins brownish: sometimes a dusky spot obvious at base of membranes between dorsal spines I and II, posterior margin of caudal fin with a fine white margin, edges of both lips are dark in alcohol; caudal fin with indistinct vertical dusky bars; dark spot on base of pectoral may cover most of its base in some specimens; figure 8. (Hawaiian Islands, Central and West Pacific, Indian Ocean.)

taeniurus Cuvier and Valenciennes

FIGURE 8.—*Scarus taeniurus*, after specimens 160 to 170 mm. in standard length. (Sketches by author.)

16*b*. Dorsal and caudal fins yellow; no dark spot on dorsal fin; no white margin distally on caudal fin; in alcohol, 2 or 3 light streaks may occur on belly, one streak on each scale row; distal margin of anal fin may have a narrow blue band basally, the rest of fin is light reddish brown; no radiating streaks around eye; plate 10,A. (Central and West Pacific, Indian Ocean.)
dubius Bennett

15*b*. Coloration not plain brownish; caudal fin with its distal margin marked by a dusky band or pale band; edges of both lips narrowly pale; caudal fin with indistinct lengthwise dusky streaks; distal margin of anal fin with a dusky band or green band equal in width to diameter of pupil; figures 9 and 23. (Central and West Pacific, Indian Ocean.) . . . **forsteri** Cuvier and Valenciennes

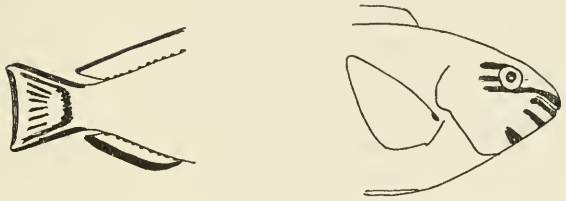


FIGURE 9.—*Scarus forsteri*. (Sketches by author.)

13*b*. Pectoral rays usually ii,13, rarely ii,12 or ii,14 (see table 3).

17*a*. Edges of dark brown dorsal, anal, caudal, and pelvics fins sharply margined with white in alcohol, blue when alive; body plain brown; forehead of adult above eyes with rounded swelling; caudal fin truncate or rounded; plate 11,A. (Western Indian Ocean.)
cyanescens Cuvier and Valenciennes

17*b*. Color not as above.

18*a*. Background coloration reddish or brownish red when alive, brown in alcohol, with 4 or 5 darker bars on sides, separated by paler interspaces; when alive the darker bars, usually purplish brown, may be somewhat obscure; all fins brownish red; plate 11,B. (West Pacific.)
rhoduropterus (Bleeker)

18*b*. No light and dark vertical bars on body.

19*a*. Pale streak extends from the mouth to below eye but not touching eye, thence bends ventrally and ends on opercle opposite upper base of pectoral; edge of upper lip pale, then a dusky (green when alive) streak; anal fin with an oblique bar (red or greenish red when alive) across its middle portion, remainder of anal fin pale (probably yellowish when alive); figure 10. (West Pacific) . . . . . **troscheli** Bleeker

FIGURE 10.—*Scarus troscheli*, USNM 87933, with green color markings in black: *a*, head; *b*, dorsal fin; *c*, anal fin. (Sketches by author.)

19*b*. Streak extends from corner of mouth to eye, touching eye, thence to upper edge of pectoral base, a less distinct streak extends from corner of mouth across cheek to lower part of pectoral base, these two streaks enclosing a pale area (yellowish when alive); anal fin crossed near its center by a light (red when alive) streak; for other marks around the head see plate 11,c. (West Pacific.) . . . **bleekeri** (Weber and de Beaufort)

19*c*. Color pattern not as in 19*a* and 19*b*.

20*a*. Caudal peduncle and caudal fin pale with a dark blotch at base of caudal fin; general background coloration grayish to brownish; the brown or reddish color phase may have several pale scales on sides posteriorly; teeth white or nearly so; plate 12,A,B. (Hawaiian Islands, Central and West Pacific, Indian Ocean.) . . . . . **sordidus** Forskål

20*b*. In green color phase, distal ⅓ of anal fin green (dusky in alcohol), with basal ⅓ reddish (pale in alcohol); edges of lips pink or red, with a green or blue streak above on upper lip that extends to below eye; red edge of lower lip interrupted near corner of mouth by a characteristically shaped blue or green mark (this is constantly present in the green color phase); middle part of body yellowish, caudal peduncle bluish or greenish; teeth green or nearly so; figure 11 . . . . . **sordidus** Forskål

FIGURE 11.—*Scarus sordidus*, adult male, with green color markings in black: *a*, head; *b* dorsal fin; *c*, anal fin. (Sketches by author.)

20*c*. Color pattern not as in 20*a* and 20*b*.

21*a*. A pale (orange or yellow when alive) blotch behind eye and expanding to include opercle and area just behind head, above pectoral fin; anal fin broadly dusky (distal ¾ green when alive), with a pale (red when alive) streak obliquely across basal part of fin; snout with dusky or purplish squarish blotch; for other color streaks on head see plate 11,D. (West Pacific.) . . . . . **bowersi** (Snyder)

21*b*. No pale blotch behind eye and behind head; distal edge of anal fin marked with a narrow dusky streak.

22*a*. Cheek with a large dark area (green when alive); dorsal surface of head pale with a large dark blotch in front of interorbital space; upper lip edged with pale, above pale edge of upper lip a dark crossband on snout; edge of lower lip green; for details of color streaks see figure 12; plate 13,A. (Central Pacific.) . **jonesi** (Streets)

22*b*. No dark blotch covering cheek; dorsal surface of head and snout brownish; edge of both lips pale (pink when alive); above pale edge of upper lip a dusky (green when alive) streak that passes below ventral edge of eye to rear of opercle, below this streak, head pale (pink to yellowish when alive); corner of lower lip with a bluish or greenish mark; anal fin with three crossbands; caudal region with pale (pink when alive) spots, one on each scale; plate 12, C,D. (Central and West Pacific.)

capistratoides Bleeker

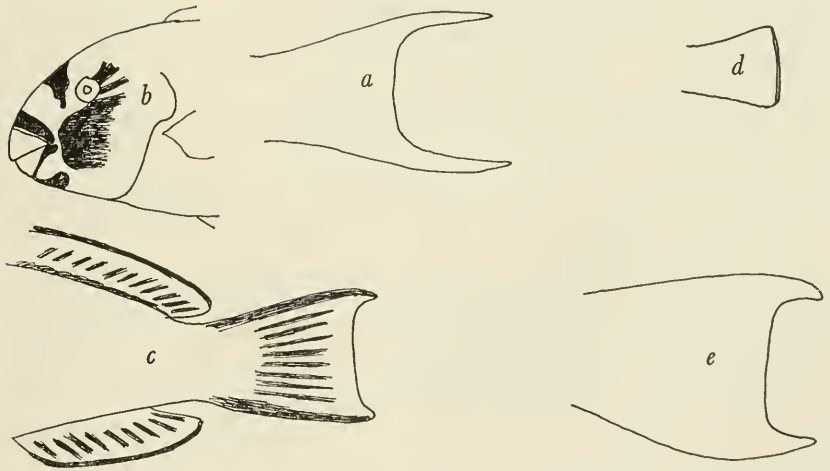


FIGURE 12.—*Scarus jonesi: a*, caudal fin of a 415-mm. specimen; *b*, and *c*, specimen 200 mm.; *d*, specimen 115 mm.; *e*, specimen 300 mm. (Sketches by author.)

2*b*. Median predorsal scales 5 to 9; scale rows on cheek 3. Subgenus *Hemistoma* Swainson.

23*a*. Dorsal surface of head in front of eye with a dark brown (purplish when alive) or greenish squarish blotch.

24*a*. An arch-shaped pale band (green when alive) from below corner of mouth passing just under orbit to opposite upper pectoral base, just above this, behind eye, a broad, dark brown, curved band; teeth white; anterior part of body and head pale, then, beginning below dorsal spines VI or VII, posteriorly dark; pectoral rays ii, 12; usually 3 scales in ventral (third) row on cheek; plate 14,A,B. (Central and West Pacific.) . . . . . **dimidiatus** Bleeker

24*b*. No arch-shaped pale band on lower side of head, as above; blue band below green blotch on snout extending back to eyes; upper lip edged with orange and extending back to eyes; pectoral rays ii,13; 2 scales in ventral (third) row on cheek; plate 18,E. (Mozambique Channel). . . . **africanus** (Smith)

23*b*. Color not as above.

25*a*. A blackish ocellate spot (sometimes lacking in preserved specimens) at base of dorsal spines III or IV; dorsal edge of pectoral base black, in some specimens this black may cover entire pectoral base; dorsal part of head brown, abruptly pale below a line from middle of snout past ventral edge of eye to upper pectoral base; anterodorsally the scales have few to several white spots (green when alive); teeth white, lips separated by an angle of 25 to 55 degrees; pectoral rays ii,12; caudal peduncle not pale; plate 14,C. (Central and West Pacific, Indian Ocean.)

globiceps Cuvier and Valenciennes

25*b*. Color not as above.

26*a*. Background color dark brown or blackish, reddish when alive, distinct white spots on numerous scales, at least posteriorly, teeth greenish when alive, turning light brownish in alcohol; pectoral rays usually ii,13.

27*a*. Scattered white spots on scales confined to posterior part of body; first soft dorsal ray elongated on adults, no white spots on pectoral fin base; plate 13,B–D. (Central and West Pacific.). . . . . **brevifillis** (Günther)

27*b*. Numerous white spots occurring on anterior and posterior parts of body; no elongate dorsal ray; usually a few white spots on pectoral fin base; plate 14,D. (West Pacific.)

singaporensis Bleeker

26*b*. Scales on sides not marked with numerous distinct white spots as above.

28*a*. Anterior half of body a rich velvety purplish black, rear half with 2 dark crossbars, 1 or 2 scales wide, separated by white bars (crimson when alive) 1 or 2 scales wide; caudal peduncle and caudal fin crimson, with a dark spot on middle of caudal peduncle; lips broadly dark crimson; plate 14,E. (Western Indian Ocean.)

rubrofasciatus J. L. B. Smith

28*b*. Color not as above.

29*a*. Pectoral base with a distinct blackish spot at dorsal edge, or all of base may be blackish or dark brownish.

30*a*. General coloration red, with 5 dusky to purplish bars on sides; pectoral rays ii,13; teeth pink or white; plate 15,A. (West Pacific.) . . **atropectoralis** new species

30*b*. Color not plain red with 5 darker bars on sides; pectoral rays ii,12.

31*a*. Middle of side with a dusky (blue when alive) broad band from behind head to caudal peduncle; opercle blackish; general color of body and fins plain reddish, teeth white, plates 3,C, and 15,B,C. (Central and West Pacific, Indian Ocean.). . . **lepidus** Jenyns

31*b*. Head mottled with reticulated dark and pale (green and red when alive) streaks, except ventrally, where streaks are blue and red; outer ¼ of anal fin blue, basal ¾ dark reddish brown; plate 15,D. (West Pacific.) . . . . **fasciatus** Cuvier and Valenciennes

29*b*. No black spot at base of pectoral fin.

32*a*. Caudal peduncle abruptly paler than anterior part of body, this pale area (plain green when alive) begins behind a line between the last 1 to 3 rays of dorsal and anal fin; pectoral rays ii,12.

33*a*. Dorsal part of head and body, anterior to plain pale caudal peduncle, marked with vermiculated streaks, red when alive, pale in alcohol; cheek and breast marked with similar pink vermiculations on a green background; edge of upper lip red, that of lower lip green, then 2 red bars on lower jaw; caudal fin with a lunate red blotch at base and on outer rays; plate 16,A. (Central and West Pacific.) **vermiculatus** (Fowler and Bean)

33*b*. No vermiculated red or pale streaks on head or body; body, anterior to the pale caudal area, purplish brown; dorsal half of head dark purplish brown, below which a broad green band extends from snout and mouth past lower edge of eye to rear of opercle; 2 green bars on lower jaw; lower part of cheek with characteristic green bars; central part of anal fin brown; figure 13. (western Indian Ocean.) . . . . . **frenatus** Lacépède

32*b*. Caudal peduncle not abruptly paler than anterior part of body.

34*a*. Cheek below eye with a large green blotch that covers or almost covers entire area, another green streak extends forward from eye across snout; head otherwise brownish; pectoral rays ii,13, plate 16,B. (West Pacific.) . . . . . **janthochir** Bleeker

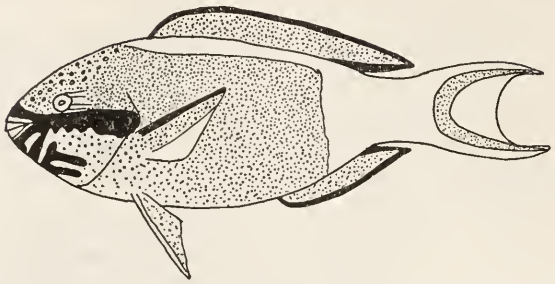


FIGURE 13.—*Scarus frenatus*, after a specimen from the Red Sea, collected by Dr. Eugenie Clark, USNM 163414, with shading as follows: Stippled areas=brownish; black=bright green, white=pale or light green. (Sketch by author.)

34*b*. Color not as above.
35*a*. Pectoral rays usually ii,13.
36*a*. Background color yellowish orange, with 5 bright blue vertical bars composed of bright blue centers of scales on about 2 rows of scales; these blue scales may preserve as dusky centers or as pale centers, more often the latter; edge of upper lip red, that of lower blue, for details of which see plate 16,C,D. (Central and West Pacific, Indian Ocean.) . . . . . **ghobban** Forskål
36*b*. Background color yellowish orange or yellowish brown or brownish, each scale of body with a distinct blue spot; cheek and caudal fin with blue spots; blue streaks on the head as shown in figure 14; plate 17,A. (West Pacific, Indian Ocean.) . . . **guttatus** Bloch and Schneider
36*c*. Color pattern not of vertical blue bars or of blue spots on nearly each scale; upper lip broadly pale edged; teeth green.

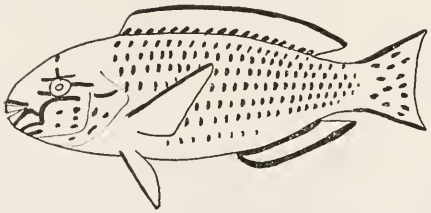


FIGURE 14.—*Scarus guttatus*, after drawings by Bleeker and by J. L. B. Smith. (Sketch by author.)

FIGURE 15.—*Scarus chlorodon*, after Bikini specimens: *a*, specimen 210 mm. in standard length; *b*, a specimen 240 mm. in standard length. (Sketches by author.)

37*a*. Back not marked with dark bars or saddles.

38*a*. Lower part of head behind mouth with characteristically U-shaped or double U-shaped green blotches sometimes joined so as to cover most of lower part of head, for shapes of blotches see figure 15; first soft dorsal ray on adults usually elongated; plate 17,B,C. (Central and West Pacific, Indian Ocean.) **chlorodon** Jenyns

38*b*. A broad green band across anterior lower part of head, without any U-shaped green blotches behind this green band; body generally dusky or brownish with an indistinct pale green bar, 2 or 3 scales wide, dorsally on middle of body below last two dorsal spines and first soft ray; for other characteristic color marks see figure 24. (Red Sea.) **marshalli**, new species

38*c*. General color blue, or grayish dorsally in alcohol, yellowish ventrally; margins of scales on back and sides yellowish, centers green; a blue bar across forehead between eyes, becoming indistinct posteriorly; blue band from angle of mouth to eye and thence around tip of snout; third blue band from angle of mouth downward and thence forward across chin; dorsal and anal brick red, with blue or green streak basally and a broad green margin; caudal pinkish with upper and lower rays blue; pelvics pinkish; pectorals yellowish, upper rays blue or green; no ray of dorsal fin elongated; greatest depth 2.3 to 2.5; figure 16. (East Pacific.) . . . . . **azureus** Hildebrand

FIGURE 16.—*Scarus azureus.* (Sketch by author.)

37*b*. General color brownish, sometimes with 4 or 5 darker brown bars on sides (blue in life), these about 3 scales wide; distal margins of dorsal and anal fins narrowly blue or green edged; no blue or green streak at base of dorsal or anal, center of these fins orange, green spots basally; dorsal edge of pectoral fin blue-green; dorsal and ventral edge of caudal blue-green; streaks on head as shown in sketch of color pattern; none of the dorsal rays elongated; greatest depth usually 2.6 to 3.0; figure 17 and plate 17,D. (East Pacific, Galápagos Island.) **noyesi** Heller and Snodgrass

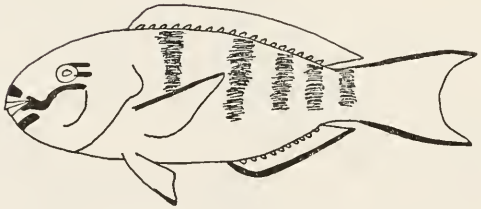


FIGURE 17.—*Scarus noyesi.* (Sketch by author.)

35*b*. Pectoral rays ii,12 or ii,13; general background color brownish, scales dorsally and on upper sides with pale edges, centers brownish green; dorsal and anal narrowly edged with green, center and base with short green bars, but no basal green streak; chin pale; depth usually 2.3 to 2.5; figure 18. (East Pacific.) . . . **californiensis** (Pellegrin)

35*c*. Pectoral rays usually ii,12, except sometimes ii,13 in ***aeruginosus***.

39*a*. Two to five alternating pale and dark vertical bars on back and dorsal part of sides; teeth white.

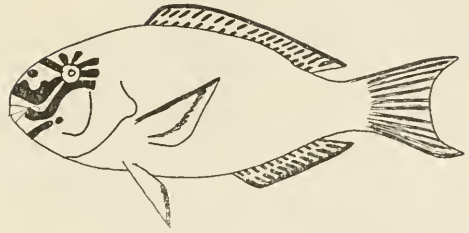


FIGURE 18.—*Scarus californiensis*, 455 mm. in standard length. (Sketch by author.)

40*a*. Four or five light and dark vertical bars on dorsal part of sides and on back; dorsal part of head dark, abruptly paler below a line extending from corner of mouth to lower edge of eye, thence to rear of opercle opposite dorsal edge of pectoral base; lips cover or nearly cover the teeth; plates 3,B, and 18,A. (Central and West Pacific, Indian Ocean.)
scaber Cuvier and Valenciennes

40*b*. The dark back broken by two or sometimes three light yellowish bars that slant forward as they pass ventrally; dorsal part of head dark, abruptly paler below level of lower edge of eye, thence to angle of opercle above pectoral base; plate 18,B. (Central and West Pacific, Indian Ocean.)
oviceps Cuvier and Valenciennes

39*b*. Body not marked with light and dark vertical bars.

41*a*. Background coloration dark brown or brownish, the margins of dorsal and anal fins pale or whitish (bright blue when alive), contrasting sharply with the dark brown basal ⅓ or more of those fins, the inner edge of this whitish margin is set off with a dark line; edges of both lips pale, upper one broadly so; teeth green, olive in alcohol.

42*a*. Background plain dark brown; usually a pale spot (greenish when alive) occurs on the lateral line scale at upper edge of gill opening; cheek plain brownish; figure 19; plate 18,C. (Central and West Pacific, Indian Ocean.) . . . . . **niger** Forskål

42*b*. Background coloration brown with numerous dark violet horizontal streaks on sides; lower side of head with bright green spots, pale in alcohol; plate 18,D. (Western Indian Ocean.)
madagascariensis (Steindachner)

41*b*. Color not as above.

43*a*. Dorsal surface of head and opercle reddish brown; snout and area behind mouth green; lower part of head orange with narrow wavy blue streaks or lines and a few blue dots or spots; plate 19,A. (West Pacific, Indian Ocean.)
blochi Cuvier and Valenciennes

43*b*. Color not as above.

FIGURE 19. *Scarus niger:* after specimens, 117 and 158 mm. in standard length. (Sketch by author.)

44*a*. Head and body plain light brownish or grayish with 2 or 3, occasionally 4, light streaks (yellowish when alive), one on each scale row of belly; no color marks on head; scales under pectoral fin not black edged; plates 3,A, and 19,B. Hawaiian Islands, Central and West Pacific, Indian Ocean.)
aeruginosus Cuvier and Valenciennes

44*b*. Color not as above.

45*a*. Sides with scales under pectoral fin black edged; young and half-grown specimens marked with light and dark streaks on sides and lower sides; head with light and dark bars as shown in figure 20; plate 19,C. (Central Pacific.)
randalli, new species

45*b*. Color not as above.

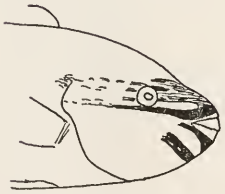


FIGURE 20.—*Scarus randalli*, new species, after holotype and paratypes. (Sketch by author.)

46*a*. Anal and dorsal fins of one plain color, no dusky margin; dorsal fin grayish green; anal red; head and back dark grayish green; middle of side behind head with a broad blue band that remains as a dusky or bluish band in alcohol; ventral part of body yellowish orange, pale in alcohol; caudal fin red; lower part of head dark purple; plate 15,B. (Central and West Pacific, Indian Ocean.)
lepidus Jenyns

46*b*. Anal and dorsal fins crossed with 2 or 3 light and dark lengthwise bands.

47*a*. Anterodorsal part of head and body dark brown above a line from middle of snout past lower edge of eye, thence above pectoral fin base, meeting a vertical line through base of dorsal spines VII or VIII; remainder of body pale (green or blue when alive); a green streak from snout below eye across cheek and opercle; figure 25 and plate 19,D. (West Pacific, Indian Ocean.)
pectoralis Cuvier and Valenciennes

47*b*. Anterodorsal part of head and body not dark brown with rest of body paler; dorsal fin edged with blue distally and basally, central ⅓ plain pink; anal similar, but pink central portion occupies about ½ to ⅔ of fin; green streak with rose border extends from snout to eye, thence 2 or 3 green streaks extend behind eye, separated by shadings of pink or rose; 2 or 3 blue bars on lower part of head; plate 20,A,B. (Central and West Pacific, Indian Ocean.)
dussumieri Cuvier and Valenciennes

Ypsiscarus, new subgenus

GENOTYPE: *Callyodon oedema* Snyder.

This new subgenus differs from all other known genera in the family in having only 3 median predorsal scales instead of 4 to 9.

Named *Ypsiscarus* in reference to the high forehead of the adult of this species.

Scarus oedema (Snyder)

PLATES 1,D; 8,D

Callyodon oedema Snyder, Proc. U. S. Nat. Mus., vol. 36, p. 603, 1909; Proc. U. S. Nat. Mus., vol. 42, p. 509, pl. 67, fig. 1, 1912 (type locality: Nafa, Okinawa; holotype USNM 62951)

This species is characterized by having only 3 median predorsal scales, 2 rows of scales on the cheek with about 5 to 7 scales in each row; ii,13 pectoral rays; whitish teeth; and a plain chocolate brown or blackish brown coloration. When alive, the coloration is plain bluish black or plain purplish black and the median fins are margined with bright blue, which may preserve as a dusky edge or a whitish edge. On large adults there is an enlargement of the forehead into a ball-like swelling; however, two specimens, USNM 147251 and 147300, 175 and 235 mm. in standard length, have not yet developed an oedemate swelling on the forehead.

In addition to the holotype I have studied specimens in lots from the following localities: Celebes, 2 lots; Philippines, 3; and Dutch East Indies, 2.

Subgenus Scarus Forskål

Scarus microrhinos Bleeker

FIGURE 4; PLATE 9,A

Scarus microrhinos Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 200, 1854 (type locality: Batavia, Java; type examined in British Museum, Cat. No. 1862.2.28.54, standard length 300 mm.)

Scarus strongylocephalus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 7, p. 439, 1854; Atlas ichthyologique . . ., vol. 1, p. 23, pl. 4, fig. 3, 1862 (type locality: Batavia, Java; type examined in British Museum, Cat. No. 1864.5.15.42, standard length 345 mm.)

Pseudoscarus microcheilos Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 231, 1861; Atlas ichthyologique . . . , vol. 1, p. 24, pl. 4, fig. 2, 1862 (Batavia, Java; type examined in British Museum, Cat. No. 1864.5.15.44, standard length 205 mm.).

Pseudoscarus microrhinos Bleeker, Atlas ichthyologique . . . , vol. 1, p. 22, pl. 3, 1862 (Java and Celebes).

Callyodon ultramarinus Jordan and Seale, Occ. Pap. Bishop Mus., vol. 4, p. 63, fig. 16, October 1906 (type locality: Mangareva); Bull. U. S. Bur. Fish., vol. 25 (1905), p. 332, fig. 64, Dec. 15, 1906 (type locality: Apia and Pago Pago; Mangareva; holotype, USNM 51757; 2 paratypes, USNM 51835, 51838).

Chlorurus microrhinus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 16, 1956.

Chlorurus strongylocephalus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 16, pl. 42C, F, 1956 (western Indian Ocean south on East African coast to lat. 15° S.)

Chlorurus microcheilus, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 16 pl. 44G, 1956 (western Indian Ocean and East African coast south to lat 14° S.).

This species may be recognized by its 4 median predorsal scales, 3 rows of scales on the cheek, with 3 to 8 scales in the ventral row; usually ii,14 or ii,15 pectoral rays; and by its green color in conjunction with a protruding forehead on the adult, the lower part of the head light green as contrasted with a darker coloration dorsally, and the green band on the head extending from mouth to pectoral fin base.

The lips do not cover the teeth; the angle between upper and lower lip varies from 80 degrees in specimens 100 mm. long to 110 degrees in one at 450 mm.; the inner lip joins the outer closer to the rictus than symphysis of upper lip; one or two canines begin to appear near corner of upper jaw at lengths between 200 and 300 mm., and at lengths of 300 mm. and above they may be very strong; distal margin of caudal fin truncate at 90 mm., slightly concave at 125 mm., strongly concave at 200 mm., and the upper and lower rays greatly elongate at 450 mm.; the shortest caudal ray contained in the longest 2½ to 3 times; as the young becomes adult, the shape of the head changes remarkably, the forehead enlarging and growing into a big knob in front of the eye, so that it projects a little in front of the teeth in a specimen at 450 mm.

In specimens preserved in alcohol, the background coloration is brownish; lower part of head, below a line from lower jaw to ventral part of pectoral base, abruptly pale or very light brownish, the area dorsal to this dark brownish; teeth gray, sometimes with a greenish tinge; all fins dusky to brownish; distal margin of dorsal and anal fins narrowly edged with green; membranes between rays of median fins usually greenish; edges of both lips white or pale, then a green band. Some of the specimens shorter than 150 mm. may have the centers of scales lighter brown than their edges, producing lengthwise pale streaks, usually rather faint.

In live specimens, the green color phase begins to appear at lengths between 90 and 100 mm. Fins generally green, lower part of head light greenish, edges of lips reddish, submarginally green; margin of eye greenish, iris orange; distal edges of dorsal and of anal fins greenish, submarginally the distal half of dorsal tinged with orange; distal half of scales green, anteriorly purplish brown or reddish brown; pelvics greenish; pectorals greenish brown or greenish black, the distal fifth of rays pale; distal margin and basal half of caudal dark greenish black, centrally lighter green and basally purplish black.

At lengths of 25 to 65 mm. and longer there are 4 lengthwise dark brown bands on the sides, separated by narrower pale interspaces, with the pair along upper sides separated by a pale streak along base of dorsal fin; median pale streak along midside more distinct than others; distal margin of caudal fin broadly whitish.

I have studied numerous specimens in lots from the following localities: Phoenix Islands, 1 lot; Ifaluk Atoll, 2; Marshalls, 23; Celebes, 1; Raroia Atoll, 8; Kapingamarangi Atoll, 4; and Philippines and vicinity, 29.

Bloch (Naturgeschichte der ausländischer Fische, vol. 4, p. 23, pl. 220, 1790) named *Scarus cretensis* from a painting. It was renamed *Scarus striatus* by Cuvier and Valenciennes (Histoire naturelle des poissons, vol. 14, p. 209, 1839), on the basis of Bloch's plate. This plate is so highly inaccurate that no reliance can be placed on it for identification purposes. All the dorsal rays are depicted as branched soft rays, the head is fully scaled, and the vertical rows of scales number 18, characters which do not occur for parrotfishes. Thus, I am following Weber and de Beaufort and Fowler in concluding that the plate represents a hypothetical species.

There is no doubt, however, that the specimens identified as this species are the same as those described by Bleeker as *Scarus microrhinos*.

Scarus harid Forskål

FIGURE 5; PLATE 9,B

Scarus harid Forskål, Descriptiones animalium, pp. x, 30, 1775 (type locality: Arabia).

Scarus psittacus (non Linnaeus) Forskål, Descriptiones animalium, pp. x, 29, 1775 (type locality; Red Sea).

Scarus mastax Rüppell, Atlas zu der Reise im nördlichen Afrika . . . , Fische des rothen Meeres, p. 80, pl. 21, fig. 2, 1828 (type locality; Red Sea).

Scarus collana Rüppell, Atlas zu der Reise im nördlichen Afrika . . . , Fische des rothen Meeres, p. 25, pl. 8, fig. 2, 1835 (type locality; Red Sea).

Scarus cyanurus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 261, 1839 (type locality: Red Sea; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 261).

Scarus collaris Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 265, 1839 (type locality; Red Sea).

Scarus latus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 245, 1839 (type locality; Red Sea).

Scarus longiceps Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 241, 1839 (type locality; Waigeu).

Scarus ruppelii Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 259, 1839 (type locality; Red Sea).

Scarus macrocheilos Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 60, 1854, (type locality; Halmahera; type examined in British Museum, Cat. No. 1864.5.15.31, standard length 88 mm).

Pseudoscarus mastax, Bleeker, Atlas ichthyologique . . . , vol. 1, p. 35, pl. 10, fig. 2, 1862 (Java).

Pseudoscarus macrocheilus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 38, pl. 15, fig. 1, 1862.

Scarus pinguirostratus Fowler, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 12, p. 541, pl. 21, upper fig., 1904 (type locality, Padang, Sumatra).

Callyodon apridentatus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 14, pl. 44,F, 1956 (type locality; Malindi, Kenya; type lost; fig. 44,F shows only 4 median predorsal scales, not 6 as stated by Smith).

Hipposcarus harid, J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 17, pl. 44,A,B, 1956 (Western Indian Ocean southward along East African coast to lat. 21°30′ S.).

This species is characterized by having 4 median predorsal scales, 3 rows of scales on the cheek, with 3 to 5 scales in the ventral row; usually ii,13 pectoral rays; white teeth covered by the lips; a broad preorbital distance, 2½ to 3½ times in head; and a broad naked space below the eye. Another characteristic is the concave space just in front of the eyes, which gives the snout a more or less narrow, or pointed, profile when viewed from a dorsal aspect.

The teeth are grayish white in color and are almost fully covered by the lips, only the edges being exposed; the angle between the lips does not exceed 10 degrees; the inner lip joins the outer a little closer to the rictus than to the tip of the snout; canine teeth are absent or rarely present on upper jaw; the preorbital distance is notably elongate and is contained about 2½ to 3½ times in the length of head; the least depth of the caudal peduncle is about equal to the least preorbital width (in most other species of parrotfishes with 4 median predorsal scales the least preorbital width is notably less than the least depth of caudal peduncle); the caudal fin is a little rounded in young, becoming truncate at about 100 mm. and a little concave at 200, with the outer rays somewhat elongated at larger sizes.

Specimen in alcohol 18 to 49 mm. long (perhaps longer) have a black spot at the base of the caudal fin, whereas in one 60 mm., long, from the Philippine Islands, this black spot has nearly disappeared. Our 4 specimens, 81 to 95 mm., from the Red Sea, have the outer rays of caudal fins blackish, edged with white.

The background coloration of adults is light brownish to grayish white, centers of lower scales are whitish, and distal edges of dorsal and anal fins narrowly margined with dusky.

A Philippine *Albatross* color drawing of a live specimen (USNM 112218), shows the following coloration: Head purplish gray, edge of upper lip orange; streaks about eye pink to orange; scales on head and body margined with purplish pink, centers greenish dorsally, changing to light yellowish orange on sides; underside of head with yellowish orange; distal edge of dorsal and anal fins blue, as are the outer rays of caudal fin; central part of caudal fin reddish brown, as is dorsal part of pectoral fin; membranes of dorsal and anal fins between the rays with blue spots. In a specimen from Saipan the caudal peduncle is bright yellow.

I have studied many specimens in lots from the following localities: Philippines and vicinity, 27 lots; Marshalls, 5; Guam, 2; New Guinea,

1; Raroia Atoll 5; Kapingamarangi Atoll 8; Ifaluk Atoll, 1; Palau Islands, 2; and Red Sea, 1.

Scarus javanicus Bleeker

PLATE 9,C

Scarus javanicus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 198, 1854 (type locality: Java; type examined in British Mus., Cat. No. 1864.5.15.21, standard length 205 mm.).

Pseudoscarus javanicus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 36, pl. 11, fig. 3, 1862.

Callyodon ogos Seale, Philippine Journ. Sci., vol. 4, p. 527, 1909 (type locality: Palawan Island, Philippines).

Xanothon fowleri J. L. B. Smith=*Xanothon frenatus* J. L. B. Smith (non Lacépède) Rhodes Univ., Ichthy. Bull. No. 1, 5, pl. 42,G, 1956 (type locality, western Indian Ocean).

This species is characterized by having 4 median predorsal scales, 3 rows of scales on the cheek, the ventral row represented by 1 or 2 scales; a black spot at upper base of pectoral; teeth pale or yellowish; anal fin with basal ⅔ or ¾ dusky (reddish brown when alive), and behind first 4 anal rays the distal ⅓ pale (blue when alive).

The posterior part of body of many preserved specimens, behind a vertical line at or near anal origin, abruptly paler than anteriorly, also a pale crossbar on chin is prominent on some specimens. This species is reported upon by Fowler and Bean as *Callyodon frenatus*. J. L. B. Smith (loc. cit.) gives it a new name. His description appears to include at least one additional species, as he gives the predorsal count of 4 or 5 scales, whereas I never found an overlap of 4 and 5 for any species in the family (see tables 2–5) except *Chlorurus gibbus*.

I have studied numerous specimens in the following lots: Philippines and vicinity, 43 lots; and Dutch East Indies, 2.

Scarus flavipectoralis, new species

PLATE 9,D

Scarus frenatus (not of Lacépède) Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 3, p. 770, 1852 (type locality, Celebes).

Pseudoscarus frenatus (not of Lacépède) Bleeker, Atlas ichthyologique . . . , vol. 1, p. 40, pl. 16, fig. 2, 1862.

Callyodon frenatus (not of Lacépède) Barton and Nichols, Marine Life, vol. 1, No. 4, pp. 11–13, pl., middle fig., 1946 (New Guinea).

Holotype: USNM 112217, Philippine Islands, Luzon, Pagapas Bay, Feb. 20, 1909, *Albatross*, standard length 212 mm., total length 264 mm.

Precision measurements were made on the holotype and these data are expressed in thousandths of the standard length. Length of head 307; greatest depth 359; length of snout 123; diameter of eye 54; fleshy interorbital space 104; postorbital length of head 151; least preorbital width 64; least depth of caudal peduncle 139; length of

caudal peduncle 160. Length of longest dorsal spine 160; of soft dorsal ray 146; of anal spine 75; of soft anal ray 127; of pectoral 243; of pelvic 215; of caudal 288.

The following counts were recorded: Dorsal IX,10; anal III,8 (this unusual count occasionally occurs in specimens of this genus); pectoral ii,12–ii,12; pelvics I,5–I,5; branched caudal rays 6+5; median predorsal scales 4; 3 rows of scales on the cheek with 1 scale in third (ventral) row.

The lips do not quite cover the white teeth, the angle between the lips is about 25 degrees, and the inner lip has a narrow free fold across front of the upper lip; two canines are present at the corner of the mouth, that on the lower jaw is stronger than that on the upper jaw.

In alcohol, anterior part of body dark brownish, posterior half light brownish, abruptly paler behind a line extending from base of dorsal spine VIII to anus; dorsal edge of pectoral base with a blackish spot; a pale band from snout and corner of mouth past lower edge of eye to angle of opercle; edge of lower lip dusky, then posteriorly two other dusky bands on under side of head.

A Philippine *Albatross* color drawing of the holotype, made from the live specimen, shows the anterior part of body dark brownish green, posterior half of body light green; middle of caudal peduncle yellow; pectoral fin yellow with a blue base; caudal fin orange with blue edges, and with blue and green marks; anal fin blue, with a brownish red band basally; dorsal fin blue edged, then submarginally with an orange streak, middle of fin green, basally with brownish red blotches; a green streak from snout past lower edge of eye to angle of opercle; teeth white; edge of lower lip blue, then posteriorly an orange band followed by a blue band, then orange, with a blue blotch; pelvic fins orange with blue edges.

John Randall, University of Hawaii, photographed in color a specimen of this species at Arno Atoll but the specimen was lost. The color is the same as on the *Albatross* drawing, except that the anterior part of the body is brownish purple and the base of the pectoral fin is bluish black.

This species may be recognized from its close relatives by the key. It is characterized by having 4 median predorsal scales; 3 rows of scales on the cheek, with 1 scale in the ventral (third) row; ii,12 pectoral rays; and white teeth. The dark anterior half of the body contrasts with the pale posterior half; the side of the caudal peduncle is yellow, as is the pectoral fin, the latter has a black spot at its dorsal basal edge and a blue base.

Named *flavipectoralis* in reference to the yellow pectoral fin.

In addition to the holotype, only a photograph, a drawing, and illustrations in the literature have been studied.

Scarus dubius Bennett

PLATE 10,A

Scarus dubius Bennett, Zool. Journ., vol. 4, p. 37, 1828 (type locality: Hawaiian Islands; type examined in British Museum, Cat. No. 1852.9.13.105, standard length 92 mm).

Scarus bennetti Cuvier and Valencienness, Histoire naturelle des poissons, vol. 14, p. 270, 1839 (type locality: Hawaiian Islands).—Jordan and Evermann, Bull. U. S. Fish Comm., vol. 23 (1903), pt. 1, p. 352, pl. 45, 1905.

Scarus hypselopterus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 496, 1853 (type locality: Java; type examined in British Museum, Cat. No. 1854.5.15.27, standard length 180 mm.).

Scarus moensi Bleeker Acta Soc. Sci. Indo-Néerl. vol. 8, p. 54, 1860 (type locality, Celebes).

Pseudoscarus hypselopterus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 36, pl. 8, fig. 3, 1862.

Pseudoscarus moensi Bleeker, Atlas ichthyologique . . . , vol. 1, p. 47, pl. 12 fig. 1, 1862.

This species is characterized by having 4 median predorsal scales, usually 3 rows of scales on the cheek, at least on one side, the ventral (third) row consisting of one scale, or it may be lacking; and ii,12 pectoral rays. The dorsal edge of the pectoral fin base has a small black spot, usually present in preserved specimens. This species may be mistaken for *S. aeruginosus* because it, too, when preserved, has the 2 or 3 light streaks, one on each scale row of the abdomen. Among the various species studied it is the only one in which the third, or ventral, row of scales on the cheek is present or absent. The general background coloration is brownish, with the median fins pale. When alive, the caudal and dorsal fins are yellowish and the caudal peduncle may also be yellowish.

In addition to the types I have studied numerous specimens in 92 lots from the Philippines and vicinity.

Scarus lunula (Snyder)

FIGURE 6; PLATE 10,B

Callyodon lunula Snyder, Proc. U. S. Nat. Mus.. vol. 35, p. 99, 1908 (type locality: Naha, Okinawa; holotype USNM 62236); Proc. U. S. Nat. Mus., vol. 42, p. 509, pl. 66, fig. 2, 1913.

Pseudoscarus rostratus (not of Poey or of Seale) Günther, Journ. Mus. Godeffroy, vol. 3, pt. 8, Fische der Südsee, p. 315, pl. 144, 1909 (type locality: Society Islands).

Callyodon verweyi Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 8, p. 298, 1940 (type locality: Batavia, Java).

? *Callyodon viridifucatus* J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 12, pl. 42,B,I, 1956 (type locality: Shimoni, Kenya).

Margaritodon verweyi Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 15, pl. 43, D,F, 1956 (east coast of Africa south to lat. 14° S., pl. 43,D,F show only 4 median predorsal scales, not 5 as stated by Smith).

This species is characterized by having 4 median predorsal scales, 3 rows of scales on the cheek, with 2 or 3 scales in the ventral row; ii,12 pectoral fin rays; white teeth; and by its coloration of three color streaks in the anal fin, edge of upper lip green, then pink, then a green streak from snout past lower edge of eye; especially notable is a green (possibly red) edge on operculum in front of pectoral fin base, and one or two green streaks connecting eyes across interorbital space. The dorsal part of body and the head are purplish brown. All the large adult specimens observed have a characteristic hump in front of and over the orbits.

The lips do not quite cover the white teeth, the angle between edges of upper and lower lips varies between 15 and 20 degrees; the inner lip is rather small, joining the outer lip about halfway to the symphysis; there are 1 or 2 canine teeth at the corner of mouth on upper jaw; the outer rays of caudal fin are greatly elongate on specimens 200 mm. and longer; there is a pair of scales in front of the anterior median predorsal scale that might be interpreted as a fifth median predorsal scale.

In alcohol, the background coloration is light brownish; outer edges of pelvic and caudal fins green; dorsal edge of pectoral green, and ventral to the edge is a brownish streak; outer third of anal green, middle third whitish, basal third greenish; outer fourth or fifth of dorsal green, middle whitish, basal third dark green; margin of upper lip green, then dorsally a pale band, then again dorsally a green band that extends past lower edge of eye and thence behind eye; two green bars across interorbital space between eyes, a green streak behind middle of eye, and another from upper edge of eye; narrow edge of lower lip pale, then a green bar which forms a spot on chin; this green bar is separated by a pale area from another green bar posteroventrally. Caudal fin with a pale crescent posteriorly, then a green one just anteriorly; then again anteriorly a brownish crescent that extends to the tips of the outer elongate rays.

When alive, the center of scales are green with a pinkish bar anteriorly; distal center of caudal peduncle pinkish; back darker green, belly pinkish but tinged with green along each row of scales; eye pink; all the streaks and bars described above are bright green or blue; pale areas of median fins yellowish or orange; posteroventral part of pectoral fin light pink.

Fowler and Bean in their report on the Philippine parrotfishes, mixed *lunula* with "*Callyodon janthochir.*" USNM 147248 (T. 603) and 147266 (T. 8656) from the Philippines, represent this rarely recognized species.

Smith (loc. cit.) states that there are 4 to 6 median predorsal

scales on his new *C. viridifucatus* but Mrs. Smith's color drawing shows only 4, a number which agrees with my observations on the basis of counts and coloration. I refer Smith's species to *S. lunula* with some doubt. An important character is the red margin of operculum, as shown in Smith's color drawing.

I have studied specimens in lots from the following localities: Marshalls, 1 lot; Moluccas, 2; Borneo, 2; and Philippines, 7.

Scarus formosus Cuvier and Valenciennes

PLATE 10,c

Scarus formosus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 283, 1839 (type locality: Sandwich Islands; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 585).

Pseudoscarus balinensis (in part) Bleeker, Atlas ichthyologique . . . , vol. 1 p. 39, 1862 (the specimen examined from Banda is not a type but is so listed in the British Museum, Cat. No. 1864.5.15.23, standard length 184 mm; only one specimen is listed from Bali).

Pseudoscarus spinus Kner, Sitzb. Akad. Wiss. Wien, vol. 57, pt. 1, pp. 31, 354, pl. 9, fig. 27, 1868 (type locality: Kandavu, Fiji; type examined in British Museum, Cat. No. 1869.11.12.53).

Callyodon upolensis Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 319, fig. 59, 1906 (type locality: Apia, Samoa; holotype, USNM 51751).

Callyodon kelloggi Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 327, fig. 62, 1906 (type locality: Apia, Samoa; holotype USNM 51746).—Barton and Nichols, Marine Life, vol. 1, No. 4, pp. 11–13, pl. upper fig. 1946 (New Guinea).

This species is characterized by having 4 median predorsal scales, usually with a pair in front of the anteriormost median scale, 3 rows of scales on the cheek, with 1 or 2 scales in the ventral row; white teeth; and ii,12 pectoral rays. The color pattern is shown in plate 10,c. The young of *S. formosus* have dark and light streaks on the sides of the body. In the adult the forehead is enlarged, giving to the head a strongly convex dorsal contour.

The lips do not quite cover the white teeth, the angle between edges of upper and lower lips varies between 10 and 20 degrees; the inner lip joins the outer near the symphysis; 1 or 2 canine teeth occur near the corner of the mouth on adults; distal margin of caudal fin a little rounded in young, becoming forked in adults.

In alcohol, the two small specimens (52 and 81 mm.) are plain light brownish with traces of dark and light streaks on the sides. The color pattern of the adult is illustrated in the plate.

The color when alive is described in the following notes, provided by John Randall: "Green with scales rimmed in rose; region of pectoral and posterior part of head below eye and behind eye dull yellowish tan, grading to yellow ventrally and to yellow-orange anteroventrally; upper part of head bright green; upper lip yellowish green; on chin,

irregular areas of turquoise blue that connect with the green snout; three blue spots on midline anterior to pelvics; dorsal and anal fins with three color streaks—base green, center orange, distal portion blue; caudal with dorsal and ventral edges blue, then an orange band, then a blue one, grading to a large bright green middle region; pectoral dark blue-green with clear rays posteriorly; a broad dull orange band on about second to sixth rays, extending almost to tips of these rays; pelvics blue with an orange lengthwise band in middle of fin.

In addition to the types, I have studied specimens in lots from the following localities: Ifaluk Atoll, 1 lot; Philippines, 1; Marshalls, 1; and Hawaiian Islands, 1.

Scarus lauia Jordan and Evermann

FIGURE 7

Scarus lauia Jordan and Evermann, Bull. U. S. Fish. Comm., vol. 22 (1902), p. 196, 1903 (type locality: Hilo and Honolulu); Bull. U. S. Fish. Comm., vol. 23 (1903), pt. 1, p. 355, pl. 43, 1905 (holotype USNM 50648, paratype 52813).

This species is characterized by having white teeth, 4 median predorsal scales, 3 rows of scales on the cheek, with about 2 scales in the ventral row; ii,12 or 13 (usually ii,12) pectoral rays; and by having the margins of both lips blue, that of the upper lip continuous to below eye; dorsal and anal fins broadly green-edged then a middle pale or orange area, bases of these fins with green spots; see figure 7 (p. 35).

In addition to the types, I have studied one lot from the Hawaiian Islands.

Scarus perspicillatus Steindachner

FIGURE 21

Scarus (*Scarus*) *perspicillatus* Steindachner, Denkschr. Akad. Wiss. Wien, vol. 41, p. 16, pl. 4, fig. 1, 1879 (type locality, Sandwich Islands).

Scarus miniatus Jenkins, Bull. U. S. Fish. Comm., vol. 19 (1899), p. 62, fig. 20, 1900 (type locality: Hawaiian Islands).

Scarus ahula Jenkins, Bull. U. S. Fish Comm., vol. 19 (1899), p. 61, fig. 19, 1900 (type locality: Hawaiian Islands).

Scarus barborus Jordan and Evermann, Bull. U. S. Fish. Comm., vol. 22 (1902), p. 197, 1903 (type locality: Honolulu; holotype USNM 50649, paratype 125361).

Callyodon borborus Jordan and Evermann, Bull. U. S. Fish. Comm., vol. 23 (1903), p. 349, fig. 150, 1905 (Honolulu; emended spelling).

Scarus kraussi E. K. Jordan, Proc. U. S. Nat. Mus., vol. 66, art. 33, p. 30, pl. 2, fig. 1, 1925 (type locality: from Honolulu Market; holotype USNM 87417).

Scarus leucostigma Jordan, Evermann, and Tanaka, Proc. California Acad. Sci., vol. 16, No. 20, p. 676, pl. 24, fig. 2, 1927 (type locality: Honolulu).

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek, the second row with 0 to 3 scales; ii,13

pectoral rays; white teeth; and the angle between the lips varying between 30 and 60 degrees.

The color pattern on the head of the males has pale or dusky lines margining a few characteristic blotches shaped as shown in the figure;

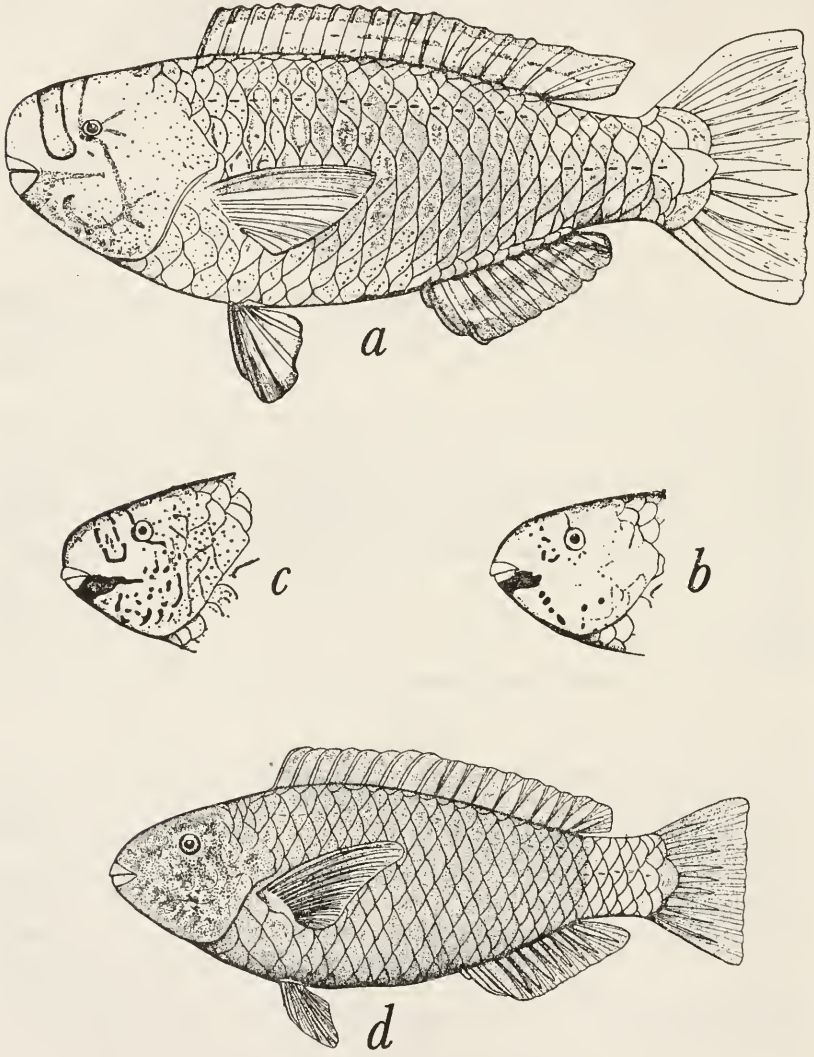


FIGURE 21.—*Scarus perspicillatus: a*, adult male; *b*, and *c*, males, showing variability of color markings on head; *d*, adult female. (Drawings by Vernon Brock, reproduced by his permission.)

in live specimens, these narrow lines on the head are a brilliant blue-green; the caudal fin distally is broadly marked with green. Anterior part of body with numerous small green dots; centers of scales green posteriorly; and dorsal rays of pectoral fin green, remainder of fin brownish.

The female, usually called *S. ahula*, is plain brownish, with a pale caudal peduncle and none of the bright blue lines on the head as in the male.

In the young, represented by *S. barborus*, the caudal peduncle is not yet pale and the scales are more distinct on the cheek, evidently becoming more or less embedded in the largest adults. The smallest specimen seen by me measures 25 mm. in standard length and came from Laysan Island.

The base of the anal fin is dark brown, with the distal half pale or white; the pale caudal peduncle may have a few green centered scales; and the side of the head may have some green dots. Vernon E. Brock and Yoshio Yamaguchi (Copeia, No. 2, pp. 154–155, 1954), should be credited with the discovery that this species has a sexual dimorphic color pattern.

In addition to the types studied, I have examined numerous specimens in lots from the following localities: Hawaiian Islands, 14 lots; Laysan Island, 11; and Johnston Island, 7.

Scarus schlegeli (Bleeker)

PLATE 10,D

Pseudoscarus schlegeli Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 242, 1861 (type locality: Celebes); Atlas ichthyologique . . . , vol. 1, p. 48, pl. 12, fig. 2, 1862 (Celebes).

Scarus cypho Seale, Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 95, 1901 (type locality: Guam).

? *Pseudoscarus collana* var. *eques* Steindachner, Denkschr. Akad. Wiss. Wien, vol. 71, p. 151, 1907 (type locality: South Arabia).

This species has been confused with *Scarus mutabilis*, *S. caudofasciatus*, and *S. zonularis*, all of which represent a single species. It is easily distinguished from these by having only 4 median predorsal scales and only 2 rows of scales on the cheek, whereas all others that have been confused with species with vertical dark bars have 5 or 6 median predorsal scales and 3 rows of scales on the cheek, except *S. venosus* Bleeker and *S. rhodouropterus* Bleeker, but the latter lacks a dark spot at base of upper pectoral rays and the lips are separated by an angle greater than 65 degrees. *S. venosus* differs in having 5 dark vertical bars. *S. schlegeli* may be recognized by its coloration: A black spot at the base of the upper pectoral fin ray, under soft dorsal fin 2 broad dark bars separated by a light bar, and pale coloration anterior to the first dark bar.

396816—58——5

The lips do not completely cover the grayish teeth, the angle between the lips varying from 30 to 50 degrees; the inner lip joins the outer closer to symphysis than to the corner of the mouth; usually 1 or 2 canines occur at corner of upper jaw and one at corner of lower jaw; distal margin of caudal fin slightly rounded in young to truncate in larger specimens; the outer rays a little elongated in largest specimens.

In alcohol, the background coloration is light grayish to light brownish, with two pale bars extending from dorsal fin ventrally, separated by a brownish bar; sometimes the anterior pale bar is continuous anteriorly to cover dorsal half of head; dorsal base of pectoral fin with a black spot; both lips with edges dusky, then a pale or whitish band; dorsal to the white (yellowish when alive) band is a dusky streak on snout that extends to corner of mouth, thence to lower front of eye, and under lower edge of eye; a short band extends posteriorly from dorsal edge of eye, another from behind eye; lower jaw with two dusky crossbands separated by a pale one, then a dusky streak on subopercle; caudal fin with dusky and pale roundish marks; dorsal and ventral edges of caudal fin with narrow dusky edge; dorsal and anal fins edged with a narrow dusky streak, base and center of these fins with 2 or 3 rows of dusky spots.

In live specimens the dusky spots, bars, and streaks are green; the general background coloration is purplish red and each scale is marked with a greenish bar; fins pinkish except for the green spots and green or blue streaks along their outer edges; the black basal spot on dorsal edge of pectoral fin is purple; pectoral fin tinted with purplish pink; base of pectoral rays dark greenish; each scale row ventrally with a green streak; sometimes the second green bar on lower jaw extends to the lower edge of the eye; the pale area between the dark purplish red bars below soft dorsal fin is bright yellowish, and a small area in front of the first dark bar is yellow.

I have studied numerous specimens in lots from the following localities: Marshalls, 6 lots; Philippines, 23; and Ifaluk Atoll, 2.

Scarus venosus Cuvier and Valenciennes

FIGURE 22

Scarus venosus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 212, 1839 (type locality: Bourbon Island; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1744, 2 specimens).

Pseudoscarus pentazona Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 241, 1861 (type locality: Celebes; type examined in British Museum, Cat. No. 1864.5.15.22, standard length 165 mm.); Atlas ichthyologique . . . , vol. 1, p. 46, pl. 11, fig. 1, 1862.

Xanothon pentazona J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 7, pl. 44,H, 1956 (Seychelles, East Africa to Bazaruto, lat. 21° 30′ S.).

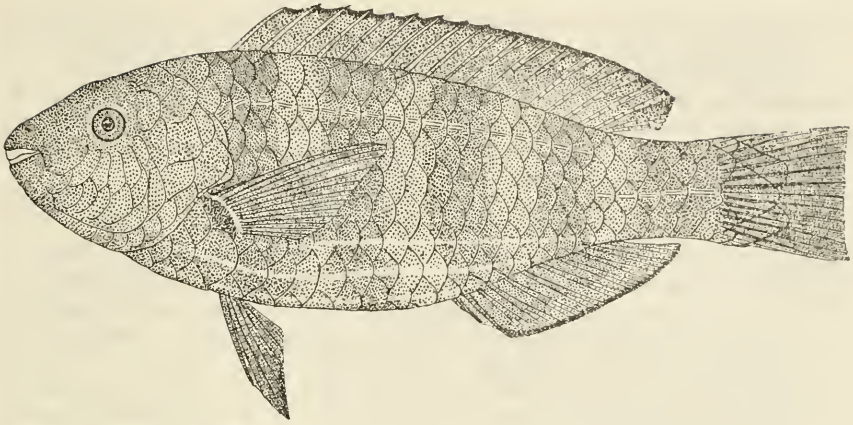


FIGURE 22.—*Scarus venosus*, USNM 147395. (Drawing by Aime M. Awl.)

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek; ii,12 pectoral rays; white teeth; and a black spot at dorsal base of pectoral fin and 5 vertical dark bars on sides, separated by pale bars about 2 scales wide. The lips do not quite cover the teeth, and the angle between lips varies from 10 to 30 degrees. *S. rhoduropterus* is similar to *S. venosus* but it has ii,13 pectoral rays and no black spot at dorsal edge of pectoral fin base, but base may be somewhat dark brown.

Scarus venosus has been confused with *S. scaber* by all recent authors because Bleeker's diagramatic figure of *S. pentazona* resembles that species in color pattern. *S. venosus*, with 4 median predorsal scales, cannot be confused with *S. scaber*, wnich has 5 or 6 median predorsal scales.

In addition to the types, I have studied 10 lots from the Philippines.

Scarus taeniurus Cuvier and Valenciennes

FIGURE 8

Scarus taeniurus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 257, 1839 (type locality: Mauritius; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 554).

Scarus scaber (in part) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 239, 1839 (type locality: Mauritius, type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1733; see *Scarus scaber* p. 92).

Scarus balinensis Bleeker, Verh. Bataviaasch Genootsch. vol. 22, p. 8, 1849 (type locality: Bali; type examined in British Museum, Cat. No. 1861.2.28.48, standard length 98 mm.).

Pseudoscarus balinensis Bleeker, Atlas ichthyologique . . . , vol. 1, p. 39, pl. 16, fig. 3, 1862 (Bali only; the specimen from Banda is *Scarus formosus*).

Pseudoscarus forskalii var. *fuscopurpureus* Klunzinger, Synopsis der Fische des rothen Meeres, pt. 2, p. 567, 1871 (type locality: Red Sea; type examined in British Museum, Cat. No. 1871.7.15.13, standard length 200 mm.).

Scarus brunneus Jenkins, Bull. U. S. Fish. Comm., vol. 19 (1899), p. 59, fig. 16, Aug. 30, 1900 (type locality: Hawaiian Islands; paratype USNM 51067).

Pseudoscarus platodoni Seale, Occ. Pap. Bishop Mus., vol. 1, No. 3, p. 96, Mar. 8, 1901 (type locality: Agana, Guam; paratype, USNM 154672).

Callyodon dubius (not of Bennett) Jordan and Evermann, Bull. U. S. Fish. Comm., vol. 23 (1903), pt. 1, pl. 44, 1905 (Hawaiian Islands).

Callyodon erythacus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 318, fig. 58, 1906 (type locality: Apia, Samoa; holotype USNM 51750).

Callyodon pyrrhurus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 314, fig. 55, 1906 (type locality: Apia and Pago Pago; holotype USNM 51748; paratypes USNM 51823, 51836, 164634).

Callyodon hornbosteli Fowler, Bull. Bishop Mus., vol. 22, p. 16, 1925 (type locality: Guam); Mem. Bishop Mus. vol. 10, p. 386, fig. 61, 1928 (Laysan; Guam).

Scarus galena E. K. Jordan, Proc. U. S. Nat. Mus., vol. 66, art. 33, p. 32, 1925 (type locality: Hawaiian Islands and Samoa; holotype USNM 87418; paratype USNM 151588).

Scarus erythacus (in part) Schultz, U. S. Nat. Mus. Bull. 180, p. 221, 1943 (Phoenix and Samoan Islands).

Xanothon carifanus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 6, pl. 42, D, 1956 (type locality: Shimoni, Kenya).

S. taeniurus belongs in the group of parrotfishes with 2 rows of scales on its cheek, 4 median scales in front of dorsal origin, and the pectoral rays are usually ii,12, with occasional exceptions. It is characterized by a rounded caudal fin in the young, becoming at most truncate in adults, with the distal margin marked with a fine white line in alcoholic specimens of all sizes and not with a broad dusky margin as in *forsteri*. The black spot at base of upper pectoral rays is evident at all ages. The edges of both lips are dark in alcohol, not pale; see figure 8 (p. 36). In the brown phase a dark spot sometimes occurs basally between dorsal spines I and II.

The lips cover or nearly cover the whitish teeth in specimens about 100 mm. and shorter, whereas in larger ones, part of the teeth may be exposed; the inner lip joins the outer lip closer to the symphysis than to the corner of mouth; no canines at corner of mouth on small specimens but on the larger adults canine teeth occur; caudal fin truncate or slightly rounded in immature specimens, largest adults have a slightly concave caudal, with the distal tips of its upper and lower lobes slightly but not notably projecting; the caudal fin retains its rounded distal margin in specimens as long as or a little longer than 160 mm.

In alcohol specimens in the gray to brown color phase (standard lengths of 94 to 200 mm.) have the background coloration grayish to reddish brown; centers of scales brownish with light brown centers; dorsal and anal fins grayish to reddish brown, edged distally with white line, below which may be a dark line; caudal fin grayish to

reddish brown, the distal margin bordered by a narrow white band, notably broader than a white line (on larger specimens there are 1 to 3 darker brown bars); pectoral fin with a blackish spot at dorsal edge of base of first few rays and on the larger specimens the base of pectoral may be brown; pelvics and pectorals pale; sometimes, on immature specimens, a dusky or blackish spot is present near base of membrane between dorsal spines I and II.

In the green color phase (standard lengths of 110 mm. and larger, the distal margin of dorsal fin is greenish, the green color occupying less than ⅓ length of the rays; light green spots at center of each ray; about ⅛ to ⅓ of distal margin of anal fin greenish, sometimes light green spots along center of fin are distinct; caudal fin with 2 or 3 dusky bars on adults, or only one on half-grown specimens, sometimes rather obscure; outer edges of caudal fin greenish; distal margin of caudal fin with a fine whitish line; midventral line of body with green streak and about 3 more on ventral side of belly, one on each row of scales; outer soft ray of pelvic green.

Edges of both lips green; a pale space separates green edge of upper lip from a green band on snout, this band continues past lower edge of eye; 2 other green bands behind eye; under side of head with 2 green bars behind the green edge of lower lip.

In the striped-color phase (standard lengths of 24 to 70 mm.) the body is reddish brown with pale streaks along each row of scales, less distinct dorsally, the light color of each scale occupies the center of the scale; fins light grayish, except that caudal fin may be light brownish, with at times a slight indication of a barred pattern.

The specimens referred to *C. fosteri* in Fowler and Bean (loc. cit., pp. 410–414) represent this species and at least one or two other species. Although their description indicates but 2 rows of scales on the cheek, some specimens identified by them have 3 rows; thus, doubt must be cast on the identifications by Fowler and Bean for *S. forsteri*. This species is close to *forsteri* and is easily confused with it and also may be mistaken for *S. capistratoides*. From the former it is distinguished by having the posterior margin of caudal fin without a submarginal blackish line; the pale margins of the dorsal and anal fins are wide in *fosteri*, narrow in *taeniurus*. A large number of the specimens identified by Fowler and Bean as *erythrodon* are *S. taeniurus* and *S. rhoduropterus*. The types of *erythaccus*, *galena*, and *brunneus*, as well as our largest specimens indicates that the green color phase of this species is not as highly developed as in some other parrotfishes. There is a possibility that the brown color phase of our large specimens are of one sex, and the green, of the other sex, but the internal organs are too far digested to work out the problem at this time.

I have studied numerous specimens in lots from the following localities: Tahiti, 1 lot; Fiji, 1; Samoa and Rose Islands, 5; Phoenix Islands, 5; Johnston Island, 2; Hawaiian Islands, 6; Marianas, 6; Marshalls, 35; New Hebrides, 1; Kapingamarangi Atoll, 2; and Ifaluk Atoll, 12.

Scarus forsteri Cuvier and Valenciennes

FIGURES 9, 23

Scarus forsteri Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 275, 1839 (type locality: Tahiti).

Scarus quoyi Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 273, 1839 (type locality: New Ireland; type examined in Mus. Nat. Hist. Nat. Paris, No. A9292).

Scarus cyanotaenia Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 6, p. 197, 1854 (type locality: Batavia, Java; type examined in British Museum, Cat. No. 1864.5.15.28).

Scarus bataviensis Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 13, p. 342, 1857 (type locality: Java; type examined in British Museum, Cat. No. 1864.5.15.45, standard length 280 mm.).

Pseudoscarus oktodon Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 235, 1861 (type locality: Buton); Atlas ichthyologique . . ., vol. 1, p. 33, pl. 13, fig. 2, 1862 (Buton).

Pseudoscarus bataviensis Bleeker, Atlas ichthyologique . . ., vol. 1, p. 48, pl. 12, fig. 3, 1862.

Pseudoscarus cyanotaenia Bleeker, Atlas ichthyologique . . ., vol. 1, p. 28, pl. 6, fig. 1, 1862.

Pseudoscarus filholi Sauvage, Bull. Soc. Philom. Paris, ser. 7, vol. 4, p. 225, 1879 (type locality: Fiji; types examined in Mus. Nat. Hist. Nat. Paris Cat. Nos. A1762–3).

Scarus gilberti Jenkins, Bull. U. S. Fish Comm., vol. 19 (1899), p. 59, fig. 17, 1900 (type locality: Hawaiian Islands; paratype USNM No. 52682).

Scarus jenkinsi Jordan and Evermann, Bull. U. S. Fish Comm., vol. 22 (1902), p. 195, 1903 (type locality: Honolulu; holotype USNM No. 50647).

Callyodon bataviensis Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 323, fig. 61, 1906 (Apia).

Pseudoscarus forsteri Günther, Journ. Mus. Godeffroy, vol. 3, pt. 8, Fische der Südsee, pl. 155, 1909.

Xanothon bataviensis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 6, 1956 (western Indian Ocean).

Xanothon capistratoides (in part) J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 6, pl. 43,B, 1956 (western Indian Ocean).

Xanothon parvidens J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 7, pl. 45,E, 1956 (type locality: Bazaruto, South Africa).

Xanothon oktodon J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 7, pl. 41,K, 1956 (East Africa to lat. 14° S., Aldabra; Seychelles; Denis and Poivre Islands.

This species may be recognized by a combination of characters: 4 median predorsal scales, 2 rows of scales on the cheek; pectoral rays usually ii,12; a black spot at base of pectoral, usually well developed; lips almost covering whitish teeth; canine teeth, usually numbering on

upper jaw 1+1, 1+2 or 2+2, and on lower jaw 1+1 or 2+2; in figure 9 (p. 37) are sketched the important color marks, chief of which are the green edges of lips, the dark line submarginally along distal edge of caudal fin, the broad pale edge (green when alive) of anal fin, and the dorsal fin set off submarginally by a dark line.

The lips nearly cover the whitish teeth in both jaws; the inner lip joins the outer much closer to the symphysis than to the corner of the mouth; well developed or strong canines occur at the corner of the mouth, their number varies in the upper jaw from 1 to 3 and in the lower jaw from 0 to 2, usually there are 1 or 2; the caudal fin is slightly concave at all sizes, with the outer rays a little elongated in the larger adults. This species increases in depth with age.

Various authors have not recognized this species and have confused it with such species as *sordidus* and *taeniurus*.

Pseudoscarus bataviensis (Bleeker, loc. cit., pl. 12, fig. 3) appears to be a drawing with the color marks of *forsteri*, except that the caudal fin is more like that of *S. taeniurus*. Probably the artist had both species.

In alcohol, specimens in the green color phase, at standard lengths of 117 to 190 mm., have the background coloration light grayish to greenish; edges of both upper and lower lips green, the band on snout

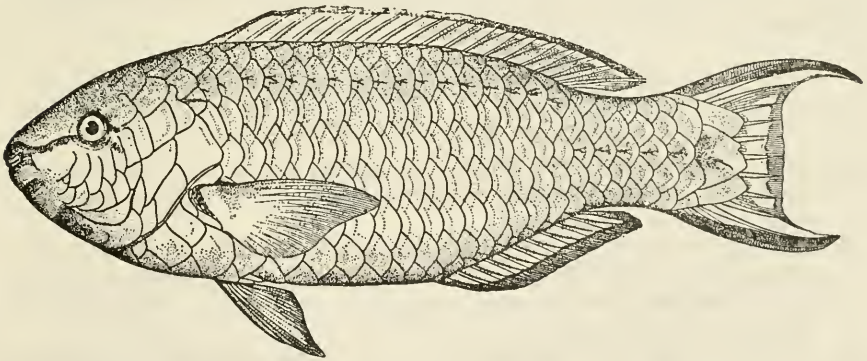


FIGURE 23.—*Scarus forsteri*, after Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25, p. 323, fig. 61, 1906).

extending to ventral part of eye, and that on lower lip to corner of mouth, these not separted by a narrow pale area; 2 other green bars on under side of head separated by pale interspaces; usually 3 short green bands behind eye separated by pale interspaces; anterior edges of pelvic fins margined with greenish; dorsal and ventral edges of caudal fin margined with green; caudal fin may have 8 other green streaks on membranes, parallel with the rays; distal margin of caudal

fin with a pale or light brownish band that persists a long time in alcohol; this band margined with a dark line basally; blackish spot always prominent at dorsal edge of pectoral base; distal margins of dorsal fin edged with green; distal margin of anal fin with a green band equal in width to half diameter of eye; the basal edges of these green bands in both dorsal and anal fin set off by a brown line; base of each soft ray greenish in both dorsal and anal fins. The breast has a green streak along each scale row and the centers of the scales on the body are greenish. A specimen from Onotoa Atoll, Gilbert Islands, 94 mm. long, shows the green color phase partly developed, especially on the fins and head. It is passing from the drab brownish coloration into that phase.

A live specimen, 142 mm. long, from Arno Atoll had the following coloration as recorded by Strasburg: Cheeks and chest salmon colored; scales green with brown borders; basal part of dorsal and anal fins salmon colored, the distal edges bluish with a dark line along the inner edge of the blue color.

I have studied numerous specimens in lots from the following localities: Hawaiian Islands, 4 lots; Samoa, 4; Fiji, 1; Tahiti, 1; Marshalls, 4; Marianas, 2; New Guinea, 2; New Hebridges, 1; Moluccas, 1; Philippines and vicinity, 21; Ifaluk Atoll, 3; Raroia Atoll 1; Christmas Island, Line Islands 1; Kapingamarangi Atoll 5; Palau Islands 2; Formosa, 1; Ryukyu Islands, 1; and Mauritius, 1.

Scarus cyanescens Cuvier and Valenciennes

PLATE 11,A

Scarus cyanescens Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 254, 1839 (type locality: Mauritius; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 586).

Scarus capitaneus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 254, pl. 403, 1839 (type locality: Mauritius; type examined in Mus. Nat. Hist. Nat. Paris; a dried skin without color and in poor condition, probably is the same as *cyanescens*).

Pseudoscarus chloromelas Playfair and Günther, Fishes of Zanzibar, p. 105, pl. 15, fig. 1, 1866 (type locality: Zanzibar).—J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 6, 1956 (on Günther).

Xanothon capitaneus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 5, pl. 41,F, 1956 (Pinda, Mozambique).

Xanothon cyanotaenia J. L. B. Smith (not of Bleeker) Rhodes Univ. Ichthy. Bull. No. 1, p. 5, pl. 42,E, 1956 (Seychelles).

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek; pectoral rays ii,13; whitish teeth; and in alcohol a plain brown coloration with the brown dorsal, anal, caudal, and pelvic fins sharply margined with white (probably blue when alive) much as in *S. niger*. This species appears to be closest to *S.*

oedema, which differs by having 3 median predorsal scales. When alive it was probably blue, green, or reddish in color.

Scarus rhodoropterus (Bleeker)

PLATE 11,B

Pseudoscarus rhodoropterus Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 233, 1861; Atlas ichthyologique . . . , vol. 1, p. 27, pl. 4, fig. 1, 1862 (type locality: Macassar, Celebes; type examined in British Museum, Cat. No. 1864.5.15.29, standard length 155 mm.).

Xanothon rhodoropterus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 6, 1956 (Seychelles; east coast of Africa from lat. 3° to 10° S.).

This is one of the species most abundantly collected by the *Albatross* in the Celebes and Philippine Seas. It has been confused with *Scarus sordidus*, with which it agrees in having 4 median predorsal scales, 2 rows of scales on the cheek and ii,13 pectoral rays, and the lips separated by an angle of 65 to 90 degrees. It differs from *sordidus* in having 4 or 5 vertical dark bars on the sides. *S. sordidus* has a pale caudal peduncle with a dark spot near the base of the caudal fin. This mark is entirely lacking in *rhodoropterus*. When alive, this species is dark reddish or reddish brown with dark purplish brown vertical bars. *Scarus sordidus* usually has a few pale or white spots on the sides posteriorly, but in *rhodoropterus* there are no pale spots. The specific identification of many preserved specimens of these two species is highly questionable.

I have studied numerous specimens in lots from the following localities: Philippines and vicinity, 131 lots; Dutch East Indies, 5; Celebes 2; Kapingamarangi Atoll 7; and Guam 1.

Scarus troscheli Bleeker

FIGURE 10

Scarus troscheli Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 498, 1853 (type locality: Batavia, Java; cotype examined in British Museum, Cat. No. 1864.5.15.19, standard length 282 mm).

Pseudoscarus troschelii Bleeker, Atlas ichthyologique . . . , vol. 1, p. 25, pl. 7, fig. 2, 1862.

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek; pectoral rays ii,13 or 14; yellowish teeth; an oblique dusky streak (probably green when alive) across the anal fin, and a distinctive pattern of streaks on the head, as shown in figure 10 (p. 38) especially the streak from corner of mouth below eye thence downward across cheek to opposite upper edge of pectoral fin base.

In addition to the cotype, I have studied a specimen from Sumatra.

Scarus bleekeri (Weber and de Beaufort)

PLATE 11,C

Callyodon bleekeri Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 8, p. 318, 1940 (type locality: Ternata).—Barton and Nichols, Marine Life, vol. 1, No. 4, pp. 11–13, pl., lower fig., 1946 (New Guinea).

Scarus quoyi Bleeker (not of Cuvier and Valenciennes), Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 607, 1853 (type locality: Ternata).

Pseudoscarus quoyi Bleeker, Atlas ichthyologique . . . , vol. 1, p. 29, pl. 6, fig. 3, 1862.

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek, with 6 to 8 scales in the second or lower row; pectoral rays ii,13; and a yellowish blotch on the head (the most distinctive part of the color pattern) that is bordered dorsally by a green streak from corner of mouth to ventral edge of eye then to upper base of pectoral, and ventrally by a similar streak from corner of mouth to lower edge of pectoral base; the green anal fin is crossed at its middle by one reddish streak, whereas the otherwise green dorsal fin is crossed by 2 red streaks; for the pattern of streaks on the head, see plate 11,c.

I have studied 36 lots from the Philippines and vicinity, and 8 from Kapingamarangi Atoll.

Scarus sordidus Forskål

FIGURE 11; PLATE 12,A,B

Scarus sordidus Forskål, Descriptiones animalium, pp. x, 30, 1775 (type locality: Arabia).

Scarus erythrodon Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 255, 1839 (type locality: Mauritius; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 575).

Scarus variegatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 256, 1839 (type locality: Mauritius; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 555).

Scarus sumbawensis Bleeker, Journ. Ind. Arch., vol. 2, No. 9, p. 638, 1848 (type locality: Sumbawa; type examined in British Museum, Cat. No. 1861. 2. 28.59, standard length 70 mm.).

Pseudoscarus sumbawensis Bleeker, Atlas ichthyologique . . . , vol. 1, p. 47, pl. 15, fig. 4, 1862.

Scarus gymnognathus Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 498, 1853 (type locality: Batavia, Java; type examined in British Museum, Cat. No. 1864.5.15.25, standard length 180 mm.).

Pseudoscarus gymnognathus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 28, pl. 15, fig. 3, 1862.

Pseudoscarus celebicus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 26, pl. 15, fig. 2. 1862 (Celebes; green color phase).

Pseudoscarus margaritus Cartier, Verh. Phys.-Med. Ges. Würzburg, vol. 5, p. 105, 1874 (type locality: Cebu).

Pseudoscarus aeruginosus (not of Bleeker) Day, Fishes of India, vol. 1, pl. 89, fig. 3, 1878 (Andamans; specimen examined in Indian Museum, Calcutta).

Pseudoscarus troschelii var. *flavoguttata* Steindachner, Sitzb. Akad. Wiss. Wien., vol. 96, pt. 1, p. 63, 1883 (type locality: Kingsmill Islands=Gilbert Islands).

Pseudoscarus goldiei Macleay, Proc. Linnean Soc. New South Wales, vol. 7, p. 590, 1883 (type locality: New Guinea).

Callyodon cyanogrammus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 330, fig. 63, 1906 (type locality: Apia, Samoa; holotype USNM 51756).

Pseudoscarus vitriolinus Bryan, Occ. Pap. Bishop Mus., vol. 2, No. 4, p. 27, 1906 (type locality: "Honolulu market").

Callyodon rostratus (not of Poey or of Günther) Seale, Philippine Journ. Sci., vol. 4, No. 6, p. 524, 1909 (type locality: Mindanao).

Callyodon albipunctatus Seale, Philippine Journ. Sci., vol. 4, p. 526, 1909 (type locality: Philippine Islands).

Scaridea leucotaeniata Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 96, p. 180, fig. 35, 1944 (type locality: New Hebrides; type examined by me).

Xanothon margaritus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 7, pl. 45,G, 1956 (East Africa to lat. 21°30′ S.; Aldabra; Seychelles).

Xanothon erythrodon J. L. B. Smith, Rhodes Univ. Ichthy. Bull, No. 1. p. 7, pl. 45,F, 1956 (western Indian Ocean).

This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek; pectoral rays usually ii,13; teeth white in young, becoming green in adult green color phase. The immature are brownish or reddish brown with a pale (pink when alive) caudal area in which is a roundish dark blotch at base of caudal fin; lips pale (yellowish to pink when alive). In the greenish stage of adult life, it is distinguished by the characteristic green and pinkish streaks or bands around the mouth and the broad green band distally on anal fin and narrow band distally on dorsal, as follows: Blue-green band above pale (pink) edge of upper lip that extends to the eye; the broad green band on lower jaw just behind pale (pink) edge of lower lip extends to eye, joining the green band from upper lip at corner of mouth, these green bands more or less fade posterioventrally without a distinct edge.

The teeth are variable in color, being whitish to olive in young and small adults, becoming greenish in the larger specimens, and dark green in the largest males; the lips are separated by an angle of 65 to 90 degrees in adults; the distal edge of the caudal fin is slightly rounded to truncate in small specimens, becoming a little concave in the larger green colored ones; the interorbital space changes from weakly convex in the smaller young to strongly convex in the larger adults.

From the smallest juvenile to the largest adult, this species passes through three color phases; the youngest are striped, the intermediate

sizes are brown, and the largest are greenish. The color marks for the phases observed pass gradually from one to the other on the large series of specimens before me, but are remarkably constant and of a definite pattern. The color in alcohol of each stage is described below.

A striped color phase was observed in specimens between the lengths of 12 to 57 mm.: A pale streak occurs along base of dorsal, below it a brownish one following anterior lateral line and ending on dorsal surface of peduncle, then 3 more brown lengthwise streaks separated by narrow pale streaks; the 2 middle brown streaks on sides each end in a brown spot at base of caudal fin rays; these alternating pale and dark streaks strongly developed on smallest specimens, 14.5 mm. in length; all fins whitish; on snout a pale V-shaped mark with apex anteriorly and ending at orbits.

A brown color phase was observed in specimens between the lengths of 50 to 190 mm.: Body varying from light brown to dark brown with caudal peduncle abruptly paler or very light brown, sometimes whitish, a large round blackish to dark brown spot at midbase of caudal fin rays, the caudal fin pale, usually same color as peduncle but distally somewhat dusky and edged with a white line; dorsal, anal, pelvic fins gray or brown to blackish, outer edge of first pelvic ray pale; pectoral pale; teeth pale or light olive, becoming faintly tinged with green in the specimens intermediate in color pattern between the brown and green color phases; opercle and interopercle usually paler than preopercle. This color phase contains both male and females. Some of the largest specimens (above 135 mm. in standard length) are females with nearly mature eggs.

A variant of the brown color phase, with a few pairs of silvery scales on sides was also observed: Mouth reddish; body purplish gray or purplish brown, with 3 pair of silvery scales posteriorly and one in middle of dusky spot on caudal fin base; dorsal fin light pinkish brown; caudal peduncle light pinkish brown, grading into light yellowish brown on caudal fin; pectoral fin pinkish. This color phase was described under the name *C. margaritus* (Cartier) in Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 8, p. 313, 1940) and in Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 7, p. 397, 1928). However, the two specimens, USNM 84242, mentioned by the latter authors, have 3 rows of scales on the cheek and are not related to this species. The original description by Cartier of *margaritus* indicates that it is a synonym of *S. sordidus*.

A green color phase was observed in specimens at lengths greater than 160 mm.: Body light olive to light brownish (greenish when alive), fins marked with green; outer ⅓ of dorsal fin green, basal ⅔ pale (red when alive); outer ⅓ of anal fin green, basal ⅔ pale (red when alive); edge of upper lip pale, then submarginally a wide green band across

snout to rictus of mouth, thence to ventral edge of eye, and across opercle; two other green streaks extend from behind eye, one from middle and the other from dorsal edge; lower lip white except posteriorly, then a submarginal broad green band of irregular shape, sometimes with a pale spot midventrally and sometimes the green band bisects the pale lip at its middle; dorsal surface of head brownish, without green spots or streaks. On some specimens the green streak above rear of eye extends forward a short distance in front of eye. Usually there is a green streak along midventral line to anal origin, then 3 others from behind head on sides of belly, fading out opposite anal origin. All specimens in this color phase that were sexed were males.

The green color phase described as *Callyodon cyanogrammus* by Jordan and Seale (loc. cit.) represents males in our collection. Centers of scales brownish red, margins light yellowish green; caudal peduncle and caudal fin green (these may preserve as pale or dusky); lips and eye reddish; pectoral fin greenish; bands on head and belly green; anal fin green, except basal ⅕ pinkish; dorsal fin green distally, pinkish in basal ⅔, with a median green streak sometimes evident, and base with a narrow green streak; cheek greenish above, pinkish below.

When alive, a dark color phase occurs in which the body is dark purplish brown or reddish brown, or purplish black; pale areas at edges of lips red, the submarginal area dark purplish brown; pelvics tinged with pinkish; caudal peduncle and caudal fin light pinkish brown; anal and dorsal fins reddish brown; centers of scales brownish, margins paler.

Through the courtesy of Dr. R. Harry, I examined the holotype of *Scaridea leucotaeniata* Fowler and find that it is a typical juvenile specimen of this species. Fowler's figure 35 is considerably in error; there are 4 median predorsal scales, and only 2 rows of scales on the cheek. His assignment of this specimen to the genus *Scaridea* is not understandable. *Callyodon abacurus* Jordan and Seale was referred to *Scarus sordidus* by Fowler and Bean and also by Weber and de Beaufort; however, the holotype (USNM 51754) and 3 paratypes (USNM 51822, 51830, 51831) of this species are *S. capistratoides*, which is quite distinct from *sordidus*.

The green color phase may easily be confused with *S. capistratoides*, but *sordidus* has 2 crossbands on anal fin and the outer ½ to ¾ of that fin dusky, whereas *capistratoides* has 3 crossbands on anal fin, all of nearly same width.

I have studied numerous specimens in lots from the following localities: Hawaiian Islands, 3 lots; Johnston Island, 2; Laysan Island, 1, Maro Reef, Hawaiian Chain, 2; Palmyra Island, 3; Christmas Island and Line Islands, 1; Phoenix Island, 1; Samoa, 7; Tahiti, 1; Marshalls, 44; Marianas, 6; New Guinea, 6; Celebes, 3; Philippines

and vicinity, 93; Kapingamarangi Atoll 1; Raroia Atoll 4; Ifaluk Atoll, 34; and Indian Ocean, 1.

Scarus bowersi (Snyder)

Plate 11,D

Callyodon bowersi Snyder, Proc. U. S. Nat. Mus., vol. 36, p. 602, 1909 (type locality: Naha, Okinawa; holotype USNM 62950); Proc. U. S. Nat. Mus. vol. 42, pl. 46, fig. 2, 1912.

This species is characterized by having white teeth; 4 median predorsal scales, 2 rows of scales on cheek, ventral (third) row absent; ii,13 pectoral rays; purplish or brownish squarish blotch (the most distinctive color mark) on dorsal surface of snout, and a red or orange area behind eye and extending from level of eye to behind head a distance about equal to postorbital part of head, thence ventrally to pectoral fin base; a reddish streak across anal fin.

I have studied 6 lots from the Philippine Islands.

Scarus jonesi (Streets)

FIGURE 12; PLATE 13,A

Pseudoscarus jonesi Streets, U. S. Nat. Mus. Bull. 7, p. 80, 1877 (type locality: Palmyra Island; 4 cotypes USNM 19221).

Scarus brighami Bryan and Herre, Occ. Pap. Bishop Mus., vol. 2, No. 1, p. 131 pl. 1903 (type locality: Marcus Island).

Scarus lupus Fowler, Proc. Acad. Nat. Sci. Philadelphia, p. 491, pl. 18, upper fig. 1, 1899 (type locality: Caroline Islands).

Callyodon latax Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 329, pl. 49, 1906 (type locality: Apia, Samoa; holotype USNM 51755; paratype 51834).

This species is characterized by having 4 median predorsal scales, 2 rows of scales on cheek, usually ii,13 pectoral rays, and characteristic green markings on front of head, as shown on figure 12 (see p. 39).

The lips partially cover the teeth in juveniles, but in adults the teeth are fully exposed, the angle being about 90 to 95 degrees between lips; the inner lip joins the outer about equidistant between the symphysis and the corner of mouth; canines are absent at corner of mouth on specimens 200 mm. and shorter, but at lengths of 300 mm. and longer a knob may appear where the teeth may be expected, 2 well developed canines occur on the upper jaw; caudal fin very slightly rounded at lengths of 80 to 100 mm., at lengths of 125 to 150 mm. it is truncate, but at larger sizes the outer rays are slightly elongate, leaving the central part truncate or nearly so.

In alcohol, specimens in the green color phase have the background coloration brownish, with center of each scale pale; caudal peduncle sometimes pale when compared with body and caudal fin,

however, there is never any round dark blotch at base of caudal fin; distal margin of caudal fin margined with pale or whitish; teeth pale or light yellowish gray.

The pectoral fin is dark in its upper ¾, pale ventrally, with distal tips of all rays pale; distal edge of dorsal and anal fins narrowly margined with a green streak; membranes between rays of median fins greenish, this sometimes confined to central portion of these fins in the form of streaks or elongate spots; in illustrations in the literature, the light and dark areas of the head, though variable to a certain extent, are remarkably characteristic and constant in pattern, especially should be noted the large dark area of the cheek, below which, on under side of head, is a pale area; dorsal surface of head pale, with a large dark blotch in front of interorbal area; the upper lip edged with pale, above which is a dark crossband, usually but not always separated from dark cheek by a narrow pale isthmus.

In the juvenile or brownish color phase, the background coloration is brownish to light brownish, each scale with a small brownish blotch; all fins light brownish to light grayish; distal edge of caudal fin narrowly margined with pale or whitish; pectoral fin plain pale. The green color phase begins to appear at about 85 to 100 mm.

In live specimens, the areas brownish in alcohol are usually greenish, thus on large specimens the scales are greenish, except the centers, which are orange; membranes between rays of median fins greenish; dorsal and ventral edges of caudal fin green, as are outer edges of pelvic fins; 2 green bands extend posteriorly behind orbit, separated by orange coloration; dorsal edge of pectoral fin green; the blotches on head that are brownish in alcohol are greenish, and pale interspaces orange; eye orange.

The juvenile coloration is grayish anteriorly, with a purplish tinge to the darker gray posteriorly.

This species might be confused with *sordidus* on the basis of having ii,13 pectoral rays; however, it differs in color pattern in three ways: (1) the distal margin of anal fin has a narrow pale streak, whereas in *sordidus* the distal half of this fin is marked with a broad band; (2) there is no dark blotch surrounded by a pale area on caudal peduncle at base of caudal fin, as in *sordidus;* (3) the interorbital in front of the eyes is marked by a large brown (green when alive) blotch, whereas in *sordidus* this area is plain brownish (plain greenish when alive).

Scarus jonesi in coloration resembles most closely *S. bowersi* (Snyder), from Okinawa, with which it might be confused. However, after studying a large series of specimens of *jonesi* and comparing these with the types of *S. bowersi* (USNM 62950), there can be no doubt that the two species are distinct. *S. jonesi* does not have the

large orange blotch on rear of head and on area above pectoral fin, nor the red streak across middle part of anal fin, as found in *bowersi;* also, it has a narrow green margin on distal edge of anal fin, whereas the distal ⅔ or ¾ of the anal fin of *bowersi* is bluish green.

In addition to the types I have studied numerous specimens in lots from the following localities: Rose Atoll, 2 lots; Phoenix Islands, 2; Fanning Island, 1; and Marshalls, 34.

Scarus capistratoides Bleeker

PLATE 12,C,D

Scarus capistratoides Bleeker, Verh. Bataviaasch Genootsch., vol. 22 (1847), p. 50, 1849 (type locality, Batavia, Java; cotype examined in British Museum, Cat. No. 1862.2.287, standard length 210 mm.).

Pseudoscarus capistratoides Bleeker, Atlas ichthyologique . . ., vol. 1, p. 29, pl. 6, fig. 2, 1862 (Batavia, Java).

Callyodon abacurus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 324, pl. 33, 1906 (type locality: Apia, and Pago Pago, Samoa; holotype USNM 51754; paratypes USNM 51822, 51830, 51831, and 163938).

Xanothon capistratoides J. L. B. Smith (in part), Rhodes Univ. Ichthy. Bull. No. 1, p. 6, pl. 43,A, 1956 (western Indian Ocean to lat. 14° S.).

This species is characterized by having white teeth; 4 median predorsal scales, only 2 rows of scales on the cheek; ii,13 pectoral fin rays; edges of dorsal and anal fins green, with middle pale, base of fins green; caudal region with pale spots, one on each scale. The drawing of the holotype of *S. abacurus* (see pl. 12,D) shows the color pattern on the head for this species rather well.

I have studied, in addition to the types, 3 lots from the Philippines and 1 from the Moluccas.

Subgenus Hemistoma Swainson

Scarus dimidiatus Bleeker

PLATE 14A,B

Scarus dimidiatus Bleeker, Acta Soc. Sci. Indo-Néerl., vol. 6, p. 17, 1857 (type locality Doreh: New Guinea; type examined in British Museum, Cat. No. 1864.5.15.24, standard length 185 mm).

Pseudoscarus dimidiatus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 41, pl. 16, fig. 1, 1862 (New Guinea).

Callyodon fumifrons Jordan and Seale, Bull., U. S. Bur. Fish., vol. 25 (1905), p. 326, pl. 34, 1906 (type locality: Pago Pago, Samoa; holotype USNM 51745; paratype USNM 61170).

This species is characterized by having 6 median predorsal scales, 3 rows of scales on the cheek, with 2 to 4 scales in the ventral row; ii,12 pectoral rays; an arch-shaped pale (greenish when alive) band from below corner of mouth passing just under orbit to opposite upper base of pectoral fin, and just above this, behind eye, a broad dark brown band that curves downward to upper pectoral base; white

teeth; the anterior part of the body and head pale, then the posterior part abruptly darker, beginning below dorsal spine VI or VII; the dorsal part of snout with a large squarish dark blotch; anal fin with distal ⅕ dark (green when alive) with a narrow pale (red when alive) basal streak. The angle between lips varies from 5 to 40 degrees.

I have studied 46 lots from the Philippines and 4 from Kapingamarangi Atoll.

Scarus africanus (Smith)

PLATE 18,E; 19,E

Callyodon africanus Smith, Mem. Mus. Dr. Alvaro de Castro, No. 3, p. 19, fig. 26 on pl. 3, and text figure 26, 1955 (type locality: southern Mozambique).

Margaritodon africanus (Smith), Rhodes Univ. Ichthy. Bull. No. 1, p. 15, pl. 42,A 1956 (East Africa south to lat. 21° S).

This species with 5 median predorsal scales, 3 rows of scales on cheek, 2 in ventral (third) row, and 13 branched pectoral rays, may be recognized by its unique coloration, namely, a large interocular dark green blotch on snout in front of eyes, "bordered below by a blue band continuous across the snout and back to eye, below which the lip is bright orange, the line reaching eye." The snout of Smith's large specimen is strongly "humped."

I have not seen a specimen.

Scarus globiceps Cuvier and Valenciennes

PLATE 14,C

Scarus globiceps Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 242, 1839 (type locality: Tahiti; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1732).

Pseudoscarus spilonotus Kner, Sitzb. Akad. Wiss. Wien, vol. 58, pt. 1, p. 352, pl. 9, fig. 26, 1868 (type locality: Fiji).

Pseudoscarus falcipinnis Playfair, Proc. Zool. Soc. Lond. p. 865, fig. 3, 1867 (type locality: Seychelles, type examined in British Museum, Cat. No. 820).

Scarus pronus Fowler, Proc. Acad. Nat. Sci. Philadelphia, p. 490, pl. 18, lower fig. 3, 1899 (type locality: Caroline Islands).

Callyodon falcipinnis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 12, pl. 44,1 (*Xanothon falcipinnis* on pl. 44) 1956 (western Indian Ocean lat. 3° to 15° S).

Callyodon globiceps J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 14, pl. 44, fig. 2, 1956 (East African coast south to lat. 14° S).

This species is characterized by having 5 or 6 median predorsal scales, 3 rows of scales on the cheek, usually with 2 or 3 in the ventral row; ii,12 pectoral fin rays; whitish teeth; tiny green (pale or dusky in alcohol) spots, usually a few to several on the anterodorsal part of body, the black ocellate spot near bases of dorsal spines III or IV may be lacking on large adults; the blackish pectoral base darker dorsally; the pale line from middle of snout to lower edge of eye, thence posteriorly, separates the pale color of lower part of head from the darker

color dorsally; another pale streak forward from middle of eye to middle of snout.

The lips do not cover the whitish teeth, the angle between upper and lower lips varies from 25 to 55 degrees; the inner lip joins the outer lip a little closer to the symphysis than to the corner of the mouth; canine teeth at corner of mouth vary from 0 to 2 in both jaws, usually 1 or 2 in specimens 200 mm. and longer; distal margin of caudal fin strongly concave, outer caudal rays elongate.

In alcohol, dorsal part of head and body grayish or light brownish, ventrally paler; head abruptly paler below a line from middle of snout past ventral margin of eye to upper pectoral base; scales with few to several small spots that may preserve as pale or dusky spots or may be entirely absent in long-preserved specimens; dorsal part of pectoral base blackish, this black may cover the entire base in some specimens; pectoral fin with pale dorsal edge, below which is a wide brownish streak, the lower half of pectoral fin pale; anal fin with dusky edge covering outer third of rays, pale centrally, with a dusky blotch at base of each ray; dorsal fin narrowly edged with dusky, rest of fin pale except for a dusky blotch on membrane between each ray and at base of each ray; a pale streak from midfront of eye forward to front of snout; other narrow pale streaks radiating from eye; usually a conspicuous dark ocellate spot at base of third or fourth dorsal spine, except on large adults.

Live specimens in the green color phase have the background coloration generally bluish green; center of scales green on posteroventral sides, those anterodorsally with a few to several small green spots or oblong spots, remainder of scales light gray or whitish; lower half of head below eye light green; pelvic and caudal fins greenish; both narrow streaks from snout to eye are green separated by light gray; pectoral fin green except for the grayish pink streak below upper rays of that fin, pectoral base purplish black.

Calloydon vermiculatus Fowler and Bean, resembles this species in coloration rather closely except the ocellate black dorsal spot is lacking, the pectoral base is not blackish, and the caudal fin lacks the lunate shaped reddish blotch.

I have studied numerous specimens in lots from the following localities: Fanning Island, 2 lots; Samoa, 1; Marshalls, 4; Mauritius, 1 lot.

Scarus brevifilis (Günther)

PLATE 13,B–D

Pseudoscarus brevifilis Günther, Journ. Mus. Godeffroy, vol. 8, pt. 16, p. 327, pl. 161, 1909 (type locality: Tahiti, and Apamana, Gilbert Islands; type from Apamana examined in British Museum, Cat. No. 1873.4.3.106, standard length 215 mm.

This species is characterized by having 5 to 7 median predorsal scales, 3 rows of scales on the cheek, with 1 to 3 scales in the ventral row; usually ii,13 pectoral fin rays; green teeth. In the young the color pattern is mottled or almost barred but in adults the background coloration is reddish brown, with a few scattered white spots posteriorly, and usually the first soft dorsal ray is a little elongate.

The lips do not cover the greenish teeth, which are notably exposed; the angle between edges of lips varies between 20 to 70 degrees; the inner lip does not join completely with outer lip, instead a free fold passes all around the front of upper lip; canine teeth are absent in the half-grown, feebly developed in the largest adults, but may number 2 on each side; distal margin of caudal fin varies from rounded in the young to deeply forked in large adults, with outer rays greatly elongate; beginning at a length of about 160 mm. the first soft dorsal ray and the soft part of tip of last dorsal spine begin to elongate; at lengths of 200 mm. and longer these rays may be notably elongated.

The color in alcohol of adults 125 mm. and longer is plain brownish or reddish brown; one or two rows of scales adjacent to bases of dorsal and anal fins with pale center or whitish center in each scale, these white marks not too obvious but constantly present; teeth green; fins brownish or reddish brown; posterior tips of caudal fin rays narrowly white lined; dorsal and anal fins of specimens 175 mm. and longer sometimes narrowly edged with dusky or green; a few pale spots on posterior half of body on centers of scales also visible on some specimens but lacking on others; pectoral fins light brown to brownish.

Young, 75 to 125 mm., in alcohol have the teeth green; background brownish or reddish brown; caudal peduncle and caudal fin slightly lighter brown than rest of body; traces of blackish bars on pectoral, dorsal, and anal fins; center of scales along base of dorsal fin pale; center of some scales pale along middle of body; sometimes pectorals plain translucent.

Juveniles, 15 to 75 mm., in alcohol have the dorsal, anal, and pectoral fins barred, caudal peduncle and caudal fin whitish or light gray; rear part of dorsal and anal fins transparent; head light brown or light gray; body behind head brown; teeth white, tinted green at 70 mm. Two juveniles, 23 and 30 mm., have the dorsal, anal, and pectoral fins barred with black; middle of body with two lengthwise streaks separated by a pale one, each dark streak ending at base of caudal fin in a small dark brown spot; each of 3 dark bars on body continue as dark saddles on the back; teeth white.

Live specimens in standard lengths of 305 and 315 mm. have the background coloration reddish brown to grayish red; head brighter red than body; teeth dark green; a grayish band, about two scale

rows wide, along lateral line from head to dorsal part of caudal peduncle (this mark completely lacking in alcoholic specimens), distal edge of anal, and outer edges of pelvics greenish; iris yellowish or orange; white silvery spots present posteriorly but these are not as sharply defined as in *S. singaporensis;* the row of scales at bases of anal and dorsal fins light grayish; occasionally a large specimen has a green band above the upper lip and one on the lower lip, below which are one or two rows of green dots.

A kodachrome of a specimen 15 inches long from Kawajalein Atoll, taken by John Randall, University of Hawaii, shows the fins bluish or purplish, the head purplish red, and only three of the pale spots discernable. The complete lack of these pale spots is not unusual for specimens from the Marshall and Gilbert Islands.

This species has been referred by Fowler as a synonym of *S. guttatus* Bloch and Schneider. I believe that both *S. guttatus* and *S. singaporensis* Bleeker are distinct from *S. brevifilis*. The latter has but a few pale spots confined to the posterior half of the body, whereas *S. singaporensis* is spotted as far forward as the head with numerous bluish white spots and *S. guttatus* lacks white spots. I examined a series of *S. singaporensis* from the Philippines and they agree with Bleeker's (1862, pl. 13, fig. 1) illustration of *S. singaporensis* and that made by the artist on the *Albatross* Philippine Expedition (pl. 14,D). *S. singaporensis* does not have any of its dorsal rays elongated, whereas all our larger specimens of *brevifilis* have an elongate first soft dorsal ray.

It should be noted that the juveniles and young of this species change their color pattern rather remarkably with growth.

I have studied numerous specimens in lots from the following localities: Palmyra Island, 2 lots; Samoa, 2; Marshalls, 20; Philippines, 4; Okinawa, 1; China Coast, 2; Ifaluk Atoll, 2; Raroia Atoll, 4; Kapingamarangi Atoll, 1; and Moluccas, 1.

Scarus singaporensis Bleeker

PLATE 14,D

Scarus singaporensis Bleeker, Nat. Tijdschr. Nederl.-Indië, Vol. 3, p. 69, 1852 (type locality: Singapore; cotype examined in British Museum, Cat. No. 1861.2.28.56, standard length 270 mm.).

Pseudoscarus singaporensis Bleeker, Atlas ichthyologique . . . , vol. 1, p. 31, pl. 13, fig. 1, 1862 (Java and Singapore).

Callyodon improvisus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 12, pl. 41,E, 1956 (western Indian Ocean to lat. 14° S.).

Collyodon singaporensis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 12, 1956 (based on Bleeker 1852).

This species is characterized by having 5 or 6 median predorsal scales, 3 rows of scales on the cheek, with 1 to 3 scales in the ventral

row; ii,13 pectoral rays; green teeth and a background of brown or greenish violet, or brownish violet coloration, with numerous scales marked with a white spot, a few of which are as large as pupil or nearly so (usually a few white spots at pectoral base and similar greenish spots may occur on the head); lips dark red; distal edge of dorsal and anal fins narrowly dark violet or brownish violet; teeth greenish when alive (they fade or change into an "alcoholic-light brownish" color after many years of preservation).

This species should not be confused with *Scarus brevifilis* (Günther), which has fewer white spots, all confined to posterior part of body; nor with *S. guttatus* Bloch and Schneider, which has white teeth.

The general coloration is dark brown or blackish or reddish brown when alive, the head dark reddish brown, as are lips; in adults, a pale greenish or grayish streak along back, and first soft dorsal ray not elongate.

I have studied numerous specimens in lots from the following localities: Celebes, 2 lots; Moluccas, 2; and Philippines, 28.

Scarus rubrofasciatus (Smith)

PLATE 14,E

Callyodon rubrofasciatus J. L. B. Smith, Ann. Mag. Nat. Hist., ser. 12, vol. 8, p. 934, December 1955 (type locality, Shimoni, Kenya, Africa); Rhodes Univ. Ichthy. Bull. No. 1, p. 10, pl. 43,I, January 1956 (type locality: Shimoni).

Smith describes this species as having 7 predorsal scales, 3 series of scales on the cheek with 2 to 4 scales in the lower row; and ii,13 pectoral rays. The pharyngeal mill has not been examined; thus, doubt may be cast on placing it in the subgenus *Hemistoma;* also, the size of the type (18 inches in total length) should indicate an adult color pattern. I have not seen a specimen.

Scarus atropectoralis, new species

PLATE 15,A

Holotype USNM 147217, Celebes, Buka Island, Nov. 20, 1909, *Albatross,* standard length 225 mm., total length 285.

Paratype USNM 157321, Celebes, Buka Island, Nov. 20, 1909, *Albatross,* standard length 260 mm., total length 340.

Precision measurements were made on the holotype and paratype and are expressed in thousandths of the standard length, respectively. Standard lengths 225 and 260 mm. Length of head 347 and 373; greatest depth 383 and 392; length of snout 147 and 158; diameter of eye 53 and 62; fleshy interorbital space 116 and 119; postorbital

length of head 156 and 165; least preorbital width 73 and 73; least depth of caudal peduncle 156 and 146; length of caudal peduncle 178 and 181. Length of longest dorsal spine 120 and 108; of soft dorsal ray 133 and 119; of anal spine 107 and 108; of soft anal ray 129 and 142, of pectoral 218 and 235, of pelvic 173 and 188, and of caudal 289 and 320.

The following counts were recorded for the holotype and paratype, respectively: Dorsal IX,10 and IX,10; Anal III,9 and III,9 pectoral ii,13–ii,13 and ii,13–ii,13; pelvics I,5 and I,5, caudal 6+5 and 6+5; median predorsal scales 6 and 6; 3 rows of scales on cheek.

The lips do not cover the whitish teeth, the angle between lips varies from 70 to 88 degrees; the inner lip continues as a narrow free fold across front of upper lip; no canine teeth are present at corner of mouth; distal margin of caudal fin concave.

In alcohol the background coloration is light brownish with 5 darker brown vertical bars; entire base of pectoral dark brown or blackish.

The color recorded on the two types, when alive, by means of a Philippine *Albatross* drawing is background bright red, fins red; teeth light pinkish; base of pectoral purplish black; 5 purplish bars on sides. The following color note was recorded on the Philippine *Albatross* Expedition: Teeth white; general color throughout scarlet vermilion, most marked on borders of scales and on fins; lower head and breast somewhat paler and centers of scales of side probably with slight purplish shade; iris more or less golden internally, externally scarlet; dusky blotch at outer base of pectoral; no bars or markings on any of fins.

These two specimens were reported upon by Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 7, 1928, p. 449) as *Callyodon caudofasciatus*.

This new species named in reference to the black pectoral fin base, may be distinguished from all other parrotfishes having 5 to 8 median predorsal scales by the general red coloration overlaid with 5 dusky or purplish vertical bars on sides. Three other species of parrotfishes, *flavipectoralis* new species, *lepidus*, and *fasciatus* have a black pectoral fin base, but none is red in color with 5 vertical bars.

This parrotfish is characterized by having 6 median predorsal scales, 3 rows of scales on the cheek with 2 scales in the ventral row; ii,13 pectoral fin rays; teeth white; and by a reddish background with 5 dark vertical bars on sides.

In addition to the types of this species, I have seen one additional specimen from Ifaluk Atoll in very bad condition but I do not consider it a paratype, as my identification is uncertain.

Scarus lepidus Jenyns

PLATES 3,C; 15,B,C

Scarus lepidus Jenyns, Zoology of the voyage of H. M. S. *Beagle* . . . , pt. 4, Fish, p. 108, 1842 (type locality: Tahiti; type examined in British Museum, Cat. No. 1917.7.14.47, standard length 180 mm.).

Scarus tricolor Bleeker, Verh. Bataviaasch Genootsch., vol. 22, p. 59, 1849 (type locality: Batavia, Java; cotype examined in British Museum, Cat. No. 1862.2.28.9, standard length 189 mm.); Altas ichthyologique . . . , vol. 1, p. 39, pl. 17, fig. 1, 1862.

Pseudoscarus forsteni Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 238, 1861 (type locality: Celebes; Moluccas); Atlas ichthyologique . . . , vol. 1, p. 38, pl. 17, fig. 2, 1862.

Callyodon latifasciatus Seale and Bean, Proc. U. S. Nat. Mus., vol. 33, p. 238, fig. 7, 1907 (type locality: Zamboanga; holotype USNM 57845; paratype USNM 61152).

Callyodon laxtoni Whitley, Rec. Australian Mus., vol. 22, No. 1, p. 94, 1948 (type locality: Ocean Island, Australia).

Callyodon viridibusius Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 459, pl. 48, 1928 (type locality: Philippine Islands; holotype USNM 89977; paratypes USNM 11981, 157068, 157326, and 160360).—Smith, Rhodes Univ., Ichthy. Bull. No. 1, p. 13, pl. 41,J, 1956 (western Indian Ocean south to lat. 14° S.).

Scarus visayanus Herre, Copeia No. 1, p. 22, 1933 (type locality: Philippine Islands; cotype examined in British Museum, Cat. No. 1933.3.11.524).

Callyodon forsteri Karmohara, Rep. Usa Mar. Biol. Station, Kochi Univ., Japan, vol. 3, No. 1, p. 3, fig. 2, 1956 (Japan).

This species has 6 or 7 median predorsal scales, 3 rows of scales on the cheek, with 2 to 6 scales in the third or ventral row; pectoral rays ii,12; teeth white or grayish. In alcohol, the body dorsally and sides are brownish or blackish above level of lower edge of pectoral base; the lower part of head and belly pale, this pale area continuing along each side of body and of anal fin to ventral edge of caudal peduncle; pectoral base dark brown.

Dr. John Randall, of the University of Hawaii, gives the following color description from a living specimen taken at Wake Island: Olivaceus-brown shading to light salmon-brown ventrally; an elongate brilliant deep blue patch running from gill opening lengthwise along body behind pectoral fin, ending just beyond tip of extended pectoral; this blotch irregularly margined by bronze-green; throat and chin and upper and lower lips bright salmon pink; teeth white; iris yellowish-orange; dorsal and caudal fins dusky orange; anal fin salmon pink; pectoral fin transparent orange.

Among 37 specimens that have the broad blue lateral band characteristic of *lepidus* we have been able to sex 12, and they were all females. Bleeker (loc. cit.) illustrated *Pseudoscarus forsteni* in his fig. 2 as having 3 pale streaks, one on each scale row on lower side of

belly. We have found 4 specimens with that color pattern and 2 of these are males; the other 2 were eviserated. This suggests that *forsteni* may represent the male. The type of *Scarus lepidus* Jenyns also has the 3 pale streaks on the lower scale rows but the sex was not determined.

I have studied numerous specimens in lots from the following localities: Philippines, 19 lots; Dutch East Indies, 2; Borneo, 2; Moluccas, 1; Ifaluk Atoll, 1; Formosa, 2; Wake Island, 1; and Okinawa, 1.

Scarus fasciatus Cuvier and Valenciennes

PLATE 15,D

Scarus fasciatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 4, p. 222, 1839 (type locality: Moluccas).

Scarus rivulatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 223, 1839 (type locality: Java).

Scarus microgmathos Bleeker, Verh. Bataviaasch Genootsch., vol. 22, p. 56, 1847 (type locality: East Indies).

Scarus rivulatoides Bleeker, Verh. Bataviaasch Genootsch., vol. 22, p. 55, 1847 (type locality: East Indies).

Pseudoscarus rivulatus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 44, pl. 9, fig. 3, 1862.

This species is characterized by having 6 or 7 median predorsal scales, 3 rows of scales on cheek, with 2 or 3 in ventral row; ii,12 pectoral fin rays; teeth whitish; base of pectoral fin dusky; anal and dorsal fins with blue edges, basal ¾ of anal reddish brown, middle of dorsal with green spots, the background coloration orange distally and becoming reddish brown basally, base of dorsal narrowly edged with green; head mottled or reticulated with narrow reddish and green marks, those on lower jaw bluish; anterior edges of pectoral and pelvic fins blue, below which, on dorsal rays of pelvic fin, a red streak, remainder of fin greenish. The caudal fin sometimes has big spots.

I have studied numerous specimens in lots from the following localities: Philippines 52 lots; Celebes, 1; Java, 1; Okinawa, 1; Malay Peninsula, 1; and Cape Arnhem, North Australia, 2.

Scarus vermiculatus (Fowler and Bean)

PLATE 16,A

Callyodon vermiculatus Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 472, pl. 49, 1928 (type locality: Philippine Islands; holotype USNM 89978, paratypes USNM 147253, 147284, 147402, 157061, 157268, and 160141).—Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 11, pl. 41,c, 1956 (East Africa to lat. 14° S., Aldabra, Seychelles, Zanzibar).

This species is characterized by having 6 or 7 median predorsal scales, 3 rows of scales on cheek, with 3 or 4 scales in the ventral

row; ii,12 pectoral fin rays; teeth bluish (in life); and by the presence on head and body of red (pale in alcohol) vermiculations in front of a plain green caudal peduncular region.

It resembles *S. globiceps* but lacks the black ocellate spot in dorsal fin, scales have pale streaks instead of spots, caudal peduncle is abruptly plain green or pale, and there is a reddish lunate marking on basal and lateral sections of caudal fin. The black pectoral base of *globiceps* is lacking in *vermiculatus*.

I have studied specimens in lots from the following localities: Phoenix Islands, 1 lot; Palmyra Island, 2; Gilbert Islands, 2; and Philippines, 1.

Scarus frenatus Lacépède

FIGURE 13

Scarus frenatus Lacépède, Histoire naturelle des poissons, vol. 4, pp. 3, 13, pl. 1, fig. 1, 1802 (type locality: Indo-Pacific Ocean [western Indian Ocean]).

Pseudoscarus frenatus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 40, pl. 16, fig. 2, 1862.

Callyodon pectoralis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 15, pl. 42,J, 1956 (east coast of Africa south to lat. 14° S.).

This species is characterized by having the anterior part of the body brownish above level of pectoral fin base and posteriorly to a line between rear of bases of dorsal and anal fins, behind which line the body is abruptly lighter green; a green band on body along each side of base of dorsal fin; head marked as shown in figure 13 (see p. 42); center of green pectoral fin reddish brown; middle and outer rays of caudal fin green, with a crescent-shaped or forklike reddish brown mark on base of caudal extending out to tip of each lobe of that fin; dorsal and anal fins margined with green, basally these fins are reddish green; teeth green; median predorsal scales 6; rows of scales on cheek 3, with 2 or 3 scales in ventral row; ii,12 pectoral fin rays.

A beautiful specimen of this species from the Red Sea, collected by Dr. Eugenie Clark, is in the National Museum. It agrees perfectly with the figure by Lacépède. Fowler and Bean did not have a specimen of this species; those reported upon by them (U. S. Nat. Mus. Bull. 100, vol. 7, pp. 436–444, 1928) from the Philippines are *S. javanicus* and a few other species.

Scarus janthochir Bleeker

PLATE 16,B

Scarus janthochir Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 139, 1853 (type locality: Ternate, Batavia).

Pseudoscarus janthochir Bleeker, Atlas ichthyologique . . . , vol. 1, p. 30, pl. 5, 1862.

Callyodon janthochir J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 14, 1856 (western Indian Ocean).

This species is characterized by having green teeth; 6 median predorsal scales, 3 rows of scales on the cheek, with about 3 scales in the ventral (third) row and ii, 13 pectoral rays. The color is green or blue-green, with dorsal half of head reddish or light brownish, contrasting with bright green side of head below eye; mouth reddish or light brownish; a green streak extends forward from eyes across snout; edges of dorsal and anal fins blue, centers of these fins yellowish brown, with green blotches on interradial membranes; pectoral fin dark blue.

I have studied specimens in 11 lots from the Philippines, 2 from Raroia Atoll, and 2 from Kapingamarangi Atoll.

Scarus ghobban Forskål

PLATE 16,C, D

Scarus ghobban Forskål, Descriptiones animalium . . . , p. 28, 1775 (type locality: Djedda, Red Sea).

Scarus pepo Bennett, . . . Fishes found upon the coast of Ceylon, ed. 2, p. 28, fig. 28, 1834 (type locality: Ceylon).

Scarus scabriusculus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 271, 1839 (type locality: Java; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 2493, skin).

Scarus hertit Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 215, 1839 (type locality: ? Red Sea).

Scarus reticulata Swainson, Natural history and classification of fishes . . . , p. 226, 1839 (type locality: Red Sea).

Scarus haridoides Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 8, p. 344, 1853 (type locality: East Indies).

Scarus pyrrostethus Richardson, Report on the ichthyology of the seas of China and Japan, *in* Rep. British Assoc. Adv. Sci. 15 Meet. 1845, p. 262, 1846 (Canton, China).—Bleeker, Atlas ichthyologique . . . , vol. 1, p. 42, pl. 9, fig. 1, 1862.

Pseudoscarus ghobban Day, Fishes of India, vol. 2, p. 412, 1878 (Andamans; specimen examined in Indian Museum, Cat. No. 681).

Pseudoscarus garretti Günther, Journ. Mus. Godeffroy, vol. 3, p. 306, pl. 153,c, 1909 (type locality: Kingsmill Island).

Scarus pyrrostethus australianus Paradice, Mem. Queensland Mus., vol. 9, pt. 1, p. 103, 1927 (type locality: Cape Wessel, Northern Australia).

Callyodon ghobban J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 10, pl. 43,H, 1956 (western Indian Ocean).

This species is characterized by having 5 or 6 median predorsal scales, 3 rows of scales on the cheek, with 1 to 3 scales in ventral row; usually ii,13 pectoral rays; the background coloration very light orange or yellowish, marked with bright blue spots in center of scales, these blue-spotted scales arranged to form 5 bars that are 2 or 3 scales wide; base and outer margins of dorsal and anal fins blue edged; dorsal and

ventral margins of caudal fin blue edged; edge of upper lip pale, then dorsally a blue blotch; lateral edge of lower lip blue, this color continues as a blue band to lower edge of eye; a blue band joins both eyes across interorbital space and other blue marks radiate from eye dorsoposteriorly; base of pectoral pinkish, not blue; dorsal edge of pectoral fin blue, the fin tinged with yellowish. These color notes are from a Kodachrome taken by John Randall, University of Hawaii, and from a painting in the *Albatross* Philippine collection.

The lips do not cover the teeth, the angle between them varies from 60 to 70 degrees; the inner lip of upper jaw appears to be free across symphysis; canines absent.

Scarus noyesi from the Galápagos Islands is very close to this species and may be the same. Especially distinctive are the 4 or 5 blue bars on sides and markings on head and fins.

I have studied several specimens in lots from the following localities: Tahiti, 1 lot; Gilbert Islands, 1; Marianas, 1; Kapingamarangi Atoll, 1; Japan, 1; and Philippines, 2.

Scarus guttatus Bloch and Schneider

FIGURE 14, PLATE 17,A

Scarus guttatus Bloch and Schneider, Systema ichthyologiae . . . , p. 294, 1801 (type locality: Indian Seas).

Scarus maculosus Lacépède, Historie naturelle des poissons, vol. 4, pp. 5, 21, pl. 1, fig. 3, 1802 (type locality: "The Great Equinoctial Ocean").

?Pseudoscarus cantori Bleeker, Atlas ichthyologique . . . , vol. 1, p. 43, pl. 9, fig. 2, 1862 (type locality: Batavia, Java; Sumatra, Singapura, Celebes, Batjan, Amboina, Timor; cotype examined in British Museum, Cat. No. 1862.2.28.3, standard length 230 mm.).

Pseudoscarus natalensis Gilchrist and Thompson Ann. South African Mus. vol. 6, pt. 3, p. 259, 1909 (type locality: Natal).

Callyodon guttatus, J. L. B. Smith, The sea fishes of southern Africa, p. 296, pl. 62, fig. 824, 1949.

This species is characterized by having white teeth; median predorsal scales 6 or 7, three rows of scales on cheek, with 1 to 3 scales in the ventral row; ii,13 or ii,14 pectoral rays; background color brown or yellowish brown with a blue or green spot on each scale; anal fin with a green or blue streak at base and distally at edge, center orange or yellowish; dorsal fin blue or green edged, basally with a blue or green spot on each membrane, center of fin yellowish; caudal fin blue or green edged, centrally yellow. Blue or green streaks on head as illustrated in figure 14 (see p. 42) and plate 17,A. Description after Smith's figure 824.

Of this species I have seen only the cotype of *P. cantori*.

Scarus chlorodon Jenyns

FIGURE 15; PLATE 17,B,C

Scarus chlorodon Jenyns, Zoology of the voyage of H. M. S. *Beagle*, pt. 4, Fish, p. 105, pl. 21, 1842 (type locality: Keeling Island, Indian Ocean; type examined in British Museum, Cat. No. 1918.1.31.12, standard length 345 mm., skin).

Scarus xanthopleura Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 499, 1853 (type locality: Java; type examined in British Museum, Cat. No. 1864.5.15. 43, standard length 360 mm.).

Pseudoscarus xanthopleura Bleeker, Atlas ichthyologique . . . , vol. 1, p. 24, pl. 7, fig. 1, 1862.

Pseudoscarus altipinnis Steindachner, Denkschr. Akad. Wiss. Wien, vol. 41, p. 18, 1879 (type locality: Kingsmill Island).—Günther, Journ. Mus. Godeffroy, vol. 8, p. 326, pl. 160, 1909 (Yap, Ponape, Ruk, Hervey Islands, Pomotous).

Callyodon waitei Seale, Occ. Pap. Bishop Mus., vol. 4, No. 1, p. 60, fig. 15, 1906 (type locality: Tahiti).

Pseudoscarus godeffroyi Günther, Journ. Mus. Godeffroy, vol. 8, p. 326, pl. 159, 1909 (type locality: Society Islands).

This species is characterized by 6 or 7 median predorsal scales; 3 rows of scales on the cheek, with 1 to 3 scales in the ventral row; usually ii,13 pectoral fin rays; green teeth; dorsal and anal fins with distal ⅓ blue or green, and basal ⅓ dark, these colors separated by a dark line. In green color phase it has characteristic light orange and dark green bars and bands on the head as shown in our figure 15 (see p. 43) and plate 17,B,C. Another characteristic is the elongate dorsal ray of large adults. Bleeker's (1862) plate 7, of *Pseudoscarus xanthopleura* presents a color pattern that is somewhat diagrammatic but is close to a specimen, 185 mm., in the National collection. Günther's (1909) plate 160, of *P. altipinnis*, is a much better illustration of the color pattern. Especially characteristic of the caudal fin is the yellowish to orange posterior margin and the green border to the dorsal and ventral edges.

The lips do not cover the greenish teeth, the angle between edges of upper and lower lips varies from 20 degrees in young to 60 degrees in adults; the inner lip joins the outer lip a little closer to symphysis than to corner of mouth; canine teeth vary from 0 to 2 or 3 on the upper jaw but are probably lacking on lower jaw; usually two canine teeth at corner of mouth on upper jaw of large specimens, but none on lower dental plate; distal margin of caudal fin truncate at 185 mm. in standard length, the outer rays becoming greatly elongate in large adults; the dorsal fin has the last dorsal spine and first soft ray greatly elongate in adults 285 to 390 mm., these two rays beginning to elongate at a length of about 185 mm.

In alcohol, specimens in the "green" color phase have a reddish brown background coloration; the caudal fin is brownish, with the

rays one-seventh pale, the edge narrowly dark lined; dorsal and ventral edge of caudal fin pale (green when alive); distal third of anal fin pale (green when alive), basal two-thirds brownish; distal edge of dorsal fin pale (green when alive), basally light brownish, except membranes are marked with large brownish blotches; pectoral fin brownish, except distally the rays are whitish, thus forming more or less distinct pale bands; pelvics light brownish with outer edge pale (green when alive). The figure (see p. 43) illustrates the general color pattern of the head, which is somewhat variable. Most characteristic are the green teeth, the pale upper lip with a dark bar dorsally, and a green dash on the lower lip at its side and rear corner, otherwise pale, then bordered below by a broad green band that continues (sometimes broken) to lower border of eye, and thence a short distance behind eye. At lengths from 375 to 390 mm. the dark bands (green when alive) on the head are broader in proportion than in smaller ones; the last dorsal spine and first soft ray are greatly elongate in the 375 to 390 mm. specimens and colored greenish. At lengths of 185 to 210 mm. the anal and caudal fins have green blotches.

When alive, the large adults are dark greenish with lighter green spots on the scales, mostly posteriorly; the pale areas of the head are orange, brightest around the mouth; eye orange; dorsal fin narrowly edged with dark green, the distal third of soft dorsal, yellowish except green edges, green elongate blotches occur near the dorsal rays; central area of anal fin orange, distal third green, basal part green; caudal fin green, except the distal margin is orange and basally there is a mixture of orange and brownish-green blotches; reddish brown specimens show the center of the scales greenish. The development of the green bars, bands, or blotches on the lower side of the head and cheek appears to be variable in extent.

Dr. William Gosline, University of Hawaii, has examined the holotype of *Callyodon waitei* Seale (BPBM 1408) and gives the number of median predorsal scales as 7, the rows of scales on both cheeks as dorsal row 6 and 6, middle row 7 and 6, and ventral row 2 and 2, both pectorals with 13 branched rays. His sketch of the color bands that still remain around the snout and lower jaw regions are characteristic for this species. In addition, Seale's color description of *waitei* is fairly accurate for this species.

Scarus formosus Cuvier and Valenciennes (Histoire Naturelle des Poissons, vol. 14, p. 210, 1839) from the Hawaiian Islands as represented in color by Valenciennes (*in* Eydoux and Souleyet, Voyage autour du Monde . . . la *Bonite*, Zoologie, vol. 1, pl. 6, fig. 3, 1841) should not be confused with *S. chlorodon*. *S. formosus* does not resemble my Kodachromes of *S. chlorodon* nor other specimens before me, and an examination of the holotype of *formosus* (see p. 56) revealed 4 median

predorsal scales instead of 6 or 7 which places *formosus* in a different subgenus.

I have studied several specimens in lots from the following localities: Guam, 2 lots; Marshalls, 5; Sumatra, 1; Raroia Atoll, 7; Kapingamarangi Atoll, 7; and Philippines, 2.

Scarus marshalli, new species

FIGURE 24

Holotype BM 1955.11.4.5, Mersa Sheikh Sa'ad, Red Sea, collected by Norman B. Marshall, standard length 280 mm.

Paratypes BM 1955.11.4.6, same data as holotype, 320 and 265 mm.

Precision measurements were made on the holotype and two paratypes and these data are expressed, respectively, in thousandths of the standard length. Standard lengths 280, 320 and 265 mm. Length of head 357, 353 and 347; greatest depth 410, 410 and 402; length of snout 164, 164 and 158; diameter of eye 54, 44 and 45; fleshy interorbital space 125, 128 and 128; postorbital length of head 157, 163 and 162; least preorbital width 79, 87 and 79; least depth of caudal peduncle 132, 138 and 136; length of caudal peduncle 175, 166 and 158; length of longest dorsal spine 143, 131 and 140; of soft dorsal ray 154,

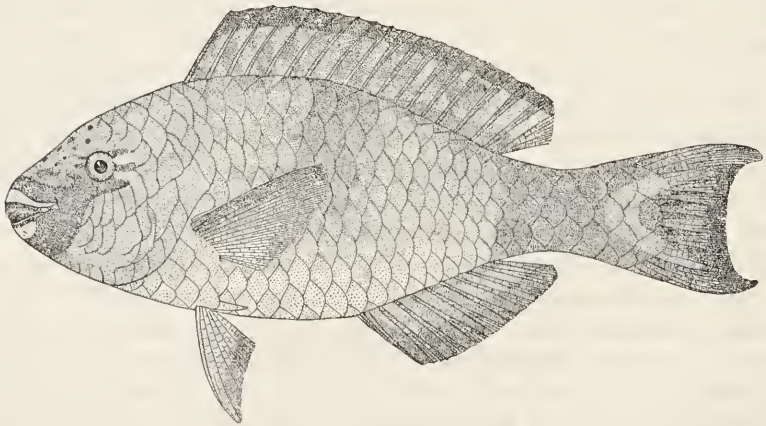


FIGURE 24.—Holotype of *Scarus marshalli*, new species. (Drawing by Aime M. Awl.)

138 and 143; of anal spine 125, 122 and 124; of soft anal ray 143, 144 and 147; of pectoral 243, 231 and 241; of pelvic 204, 206 and 215; of caudal 271, 269 and 249.

Counts were recorded in table 4 for the three types.

The lips do not quite cover the green teeth, the angle between them is about 25 to 30 degrees; the inner upper lip is joined to the outer

closer to symphysis than to corner of mouth; two canines occur at corner of upper jaw on both sides; caudal fin deeply concave.

In alcohol, the background coloration is light brownish with a greenish bar 2 or 3 scales wide across middle of body, more distinct dorsally, and beginning under membranes between last two dorsal spines and first soft ray; anal fin bright green in distal half, light green to brownish basally; dorsal fin with distal edge green, remainder of fin basally brownish or mottled green and pale; dorsal and basal part of pectoral green, distally pale; caudal fin green, with a lunate brown marking basally; upper lip broadly pale, then a broad green band that extends to eye and joins a broad green blotch on area around lower jaw; lower lip green, behind which is a pale area, then a broad green area that extends to eye and a little behind eye; dorsal surface of head and snout green spotted on a brownish background, 3 short green streaks in front of eye and 3 behind.

This species may be distinguished from other parrotfishes in the genus by means of the keys; it is characterized by having 6 or 7 median predorsal scales, 3 rows of scales on the cheek, with 1 to 4 scales in the ventral (third) row, ii, 13 pectoral rays, and a distinctive coloration as shown in figure 24, above. It differs from all other members of the subgenus *Hemistoma* in having a green vertical bar below middle of base of dorsal fin.

Scarus azureus Meek and Hildebrand

FIGURE 16

Scarus azureus Meek and Hildebrand, Marine fishes of Panama, vol. 3, p. 742, pl. 72, fig. 1, 1928 (type locality: Panama City market, Panama; holotype USNM 81778).

The color description by Meek and Hilebrand fits that of a specimen, 455 mm., from the Pearl Islands loaned by Dr. Boyd Walker, University of California, Los Angeles: ". . . in life bluish, the margin of scales on back and sides yellowish; a blue bar across forehead from eye to eye, thence backward, soon becoming indistinct; another blue band extending from underneath eye to angle of mouth, thence forward around tip of snout; a third blue band from back of angle of mouth downward and forward across chin; dorsal and anal brick red, with a narrow blue streak at base and on margin, caudal pinkish, with upper and lower rays and posterior margin sky-blue, ventrals pinkish; pectorals yellow, upper ray sky-blue; teeth pale."

The general background color is greenish dorsally, pale or yellowish ventrally with centers of scales green, and edges pale (yellowish or pinkish); chin green; dorsal half of pectoral green otherwise pale; caudal with outer rays green, center green, these green areas separated

by a broad pale streak; a pale bar on side of lower jaw appears to be characteristic on adults. The three streaks on anal and dorsal fins of *azureus* distinguish it from *californiensis*.

This species is deep bodied, depth about 2.3 to 2.5 in length, usually 6 median predorsal scales, 3 rows of scales on cheek, with 1 to 3 scales in ventral (third) row; pectoral rays ii,13; white teeth; and caudal fins deeply forked in adults; angle between lips 10 to 30 degrees on large specimens.

In addition to the type I have studied a specimen each from Panama and the Pearl Islands.

Scarus noyesi Heller and Snodgrass

FIGURE 17; PLATE 17,D

Scarus noyesi Heller and Snodgrass, Proc. Washington Acad. Sci., vol. 5, p. 206, pl. 9, 1903 (type locality: Albermarle Island, Galápagos; paratype USNM 50084).

The parrotfishes of the eastern Pacific are not well known and with the small amount of material available I am unable to work out the species with certainty. To aid in this matter I present a more detailed description of this species to supplement that of Heller and Snodgrass.

Precision measurements were made on 3 specimens and these data are expressed in thousandths of the standard length, respectively, of 355, 315, and 240 mm. Length of head 352, 343, and 325; greatest depth 360, 397, and 350; length of snout 158, 149, and 129; diameter of eye 45, 54, and 50; fleshy interorbital space 111, 114, and 103; postorbital length of head 163, 162, and 158; least preorbital width 87, 86, and 71; least depth of caudal peduncle 144, 140, and 150; length of caudal peduncle 163, 168, and 146. Length of longest dorsal spine 101, 124, and 112; of soft dorsal ray 127, 137, and 125; of anal spine 104, 108, and 100; of soft anal ray 101, 102, and 112; of pectoral 231, 232, and 225; of pelvic 180, 162, and 167; of caudal 296, 305, and 292.

The following counts were recorded: Dorsal always IX,10; anal III,9; pelvic I,5; branched caudal rays 6+5; pectoral rays ii,13 in all specimens except one, which has ii,15 rays—an unusual count, perhaps resulting from an injury not superficially evident; median predorsal scales 6, rows of scales on the cheek 3, with 2 scales in the ventral row.

Lips almost cover the whitish teeth, angle between them about 30 to 40 degrees; inner lip joined to outer closer to symphysis than to corner of mouth, canines weakly developed at corner of mouth.

In alcohol the general background coloration is brownish dorsally, yellowish orange ventrally; some specimens have 4 or 5 dark brownish green bars (blue when alive) on back and sides; distal margins of dorsal

and anal fins narrowly edged with dark green; a series of blue or green spots, one between each ray, basally on dorsal and anal fins, centers of these fins orange; dorsal edge of pectoral dark blue-green, remainder light yellowish brown; outer caudal rays darker brown (blue when alive) center of that fin dark brown; tip of chin orange; blue-green color streaks on head as shown in figure 17 (see p. 44). Life colors from a Kodachrome supplied by Loren P. Woods, Chicago Natural History Musueum.

This species may be distinguished by 6 median predorsal scales; 3 rows of scales on the cheek, with 2 scales in the ventral row; ii,13 pectoral rays; together with its generally dark brownish coloration and, sometimes, 4 dark bars on upper sides. From *S. californiensis* and *S. azureus* it differs in having a more slender form, the greatest depth varying from 2.5 to 3.0 instead of 2.3 to 2.5; head 1.0 to 1.25 in depth, shorter than or nearly equal to greatest depth.

Although I tentatively recognize *S. noyesi* as distinct, it is exceedingly close to *S. ghobban*, of the Central-West Pacific and Indian Ocean, and may be the same. A study of freshly caught specimens is needed to clarify its status.

In addition to the paratype I have studied several other specimens from the Galápagos Islands.

Scarus californiensis (Pellegrin)

FIGURE 18

Pseudoscarus californiensis Pellegrin, Bull. Mus. Hist. Nat., Paris, vol. 7, p. 163, 1901 (type locality: La Paz Bay, Gulf of California; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 00–124, standard length 365 mm.).

Callyodon compressus Osburn and Nichols, Bull. Amer. Mus. Nat. Hist. vol. 35, art. 16, p. 171, fig. 13, 1916 (type locality: Concepción Bay, off Ricasón Point, Baja California; holotype USNM 87549).

This species is very close to *S. azureus*, differing only in color pattern. The general background coloration is reddish brown, centers of scales dorsally brownish green, edges paler; dorsal and anal fins narrowly edged with green, then remainder of fins marked with short green bars parallel with rays, no green streak basally as in *azureus;* caudal fin with green streaks corresponding with rays; distal edge of pelvic green; pectoral fin with dorsal edge green and a green submarginal bar distally; chin pale; dark green marks on head as illustrated in figure 18 (see p. 45).

This is a deep-bodied species; depth 2.3 to 2.5; head 1.2 to 1.3 in greatest depth; 6 median predorsal scales, 3 rows of scales on the cheek, with 2 or 3 scales in the ventral (third) row; pectoral rays ii, 12 or ii, 13; teeth white; and caudal fin deeply forked on large adults.

396816—58——7

Scarus scaber Cuvier and Valenciennes

PLATES 3,C; 18,A

Scarus scaber (in part) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 239, 1839 (type locality: Mauritius; type material examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 588, standard length 185 mm., is herewith selected as the lectotype; see *S. taeniurus* p. 61).

Callyodon mutabilis Gray, Catalog of fish collected and described by L. T. Gronow, p. 86, 1854 (type locality: Amboina; preoccupied by *Scarus mutabilis* Lowe 1841 now in the genus *Sparisoma*).

Psuedoscarus caudofasciatus Günther, Catalogue of the fishes in the British Museum . . . , vol. 4, p. 238, 1862 (type locality: Mauritius), Playfair and Günther, Fishes of Zanzibar . . . , p. 108, 1865 (Zanzibar).

Pseudoscarus flavomaculatus Bliss, Trans. Soc. Roy. Arts Sci. Maurice, vol. 13, p. 57, 1883 (type locality; Mauritius; cotype, USNM 153567).

Callyodon zonularis Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 321, fig. 60. 1906 (type locality: Pago Pago, Samoa; holotype USNM 51752, paratypes 51821, 51825, 51827, 51828, 126618, and 163939).

Pseudoscarus caudofasciatus and var. *zonularis* Günther, Journ. Mus. Godeffroy, vol. 8, p. 312, pl. 153, figs. A?, B, 1909.

Callyodon fuscocuneus Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 158, fig. 128, 1935 (type locality: Bangkok, Siam).

Callyodon caudofasciatus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 10, 1956 (based on Günther 1862).

Callyodon scaber J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 10, pl. 41,G, 1956 (east coast of Africa from Natal northwards).

This species is characterized by having 5 or 6 median predorsal scales, 3 rows of scales on cheek, and 2 or 3 scales in ventral (third) row; ii,12 pectoral rays; teeth white; 4 or 5 dark bars separated by pale interspaces on back; no black spot at dorsal edge of pectoral base; and lips covering or nearly covering the teeth.

The species *scaber*(=*mutabilis*), *oviceps*, *pectoralis*, and *schlegeli* have been considerably confused. Among these, *schlegeli* is distinguishable from the others in having 4 median predorsal scales and only 2 rows of scales on the cheek. The others have 5 to 7 median predorsal scales and 3 rows of scales on the cheek. Gray (loc. cit.) says of his *Collyodon mutabilis*, "Color toitius dilute fuscus, in lateribus fasciae quinque transversales obscurioris coloris," indicating that he had this species. *S. scaber* has 5 dark saddles on the back separated by pale interspaces, none of which slant strongly forward, being instead nearly vertical. *S. oviceps* has 2, sometimes 3, narrow pale bars that slant forward as they descend ventrally. The teeth of *scaber* and *oviceps* are white, those of *S. pectoralis* are greenish.

Pseudoscarus pentazona Bleeker resembles *S. scaber* but differs in having 4 median predorsal scales, 2 rows of scales on the cheek, and a black pectoral spot; it is a synonym of *S. venosus* Cuvier and Valenciennes, and is not very closely related to this species.

I have studied numerous specimens in lots from the following localities: Ifaluk Atoll, 1 lot, and Philippines, 56 lots.

Scarus oviceps Cuvier and Valenciennes

PLATE 18,B

Scarus oviceps Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 244, 1839 (type locality: Tahiti; the following types were examined in the Mus. Nat. Hist. Nat., Paris, Cat. Nos. 561 and 1731g).

Pseudoscarus zonatus Macleay, Proc. Linnean Soc. New South Wales, vol. 7, p. 591, 1883 (type locality: New Guinea).

Pseudoscarus knerii Steindachner, Sitzb. Akad. Wiss. Wien, vol. 96, pt. 1, p. 64, pl. 4, fig. 1, 1887 (type locality: Madagascar?).

This species is characterized by having white teeth; ii,12 pectoral rays; 6 or 7 median predorsal scales, 3 rows of scales on cheek with 3 or 4 scales in lower row; coloration of head dark dorsally, abruptly pale ventrally below a line from snout past lower edge of orbit to above upper edge of pectoral base, near angle of opercle; the dark back broken by 2, rarely 3, light yellowish bars that slant strongly forward as they pass ventrally; lips cover or nearly cover the teeth. The young have a blackish streak from snout through eye to angle of opercle.

I have studied numerous specimens from the following localities: Samoa, 3 lots; Celebes, 1; Kapingamarangi Atoll, 6; Christmas Island and Fire Islands, 1; and Philippines, 5.

Scarus niger Forskål

FIGURE 19; PLATES 18,C; 27,B

Scarus niger Forskål, Descriptiones animalium . . ., pp. x, 28, 1775 (type locality: Red Sea); Rüppell, Atlas zu der Reise im nördlichen Afrika . . ., Fische des rothen Meeres, p. 24, pl. 8, fig. 1, 1835 (Red Sea).

Scarus nuchipunctatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 224, 1839 ("Sea of the Indies").

Scarus limbatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 271, 1839 (type locality: Java).

Pseudoscarus nuchipunctatus Bleeker, Atlas ichthyologique . . ., vol. 1, p. 31, pl. 10, fig. 2, 1862.

Pseudoscarus flavomarginatus Kner, Fische, *in* Reise der . . . *Novara*, p. 262, pl. 10, fig. 2, 1866 (type locality: Java).

Callyodon maoricus Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25 (1905), p. 328, pl. 48, fig. 3, 1906 (type locality: Pago Pago; holotype USNM 51747, paratype 51833).

Callyodon lineolabiatus Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 457, pl. 47, 1928 (type locality: Butauanan Island, Philippine Islands; holotype not studied).

Callyodon niger J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 13, pl. 43, C, G, 1956 (east coast of Africa south to lat. 14° S.).

This species is characterized by its greenish teeth (olive in alcohol); and its generally dark brown coloration, the pale or whitish margins of dorsal and anal fins constrasting sharply (in alcohol) with the dark brown basal ⅓ of those fins, the inner edge of this whitish band margined with a dark line; edges of both lips pale, the upper one broadly so, the lower a narrow line; a dark bar (greenish in life) may run from the corner of mouth to eye thence posteriorly; usually a pale spot on lateral line scale at upper edge of gill opening; and pale streaks (pink in life) extending forward and backward from eye. Some specimens are blackish or brownish all over except the pale edges on median fins.

I have a specimen, 69 mm. in standard length, from Ifaluk Atoll, collected by Dr. R. R. Harry, that probably represents the color pattern of the young of this species. The distal ⅓ of caudal fin is white, basal ⅓ brown and somewhat finely speckled with tiny darker brown specks; a black blotch basally at outer edges of caudal fin rays; and tips of dorsal and anal fin rays whitish.

A specimen, 72 mm. in standard length, collected by Dr. John Randall, has the same color as the 69-mm. specimen, except that both lips are broadly whitish. Dr. Randall states that the living colors were: "Brown with bright blue spots on body (spots fading soon after death). Anterior part of head red; ventral part of body reddish brown; green band on upper lip, chin, and from rictus to eye; pectoral yellow; distal part of caudal fin hyaline."

Two specimens, 117 and 158 mm. from near Java, have the front part of the head barred as follows: Upper lip broadly pale, thence a dark crossbar above which is a pale bar; lower lip narrowly pale edged, thence two dark bars separated by a pale area; under side of head with elongate dark bar.

I have studied very many specimens in lots from the following localities: Japan, 1 lot; China Coast, 1; Okinawa, 1; Philippines, 64; Dutch East Indies, 1; Ifaluk Atoll, 2; Kapingamarangi Atoll, 2; New Guinea, 3; and Borneo, 1.

Scarus madagascariensis (Steindachner)

PLATE 18,D

Pseudoscarus madagascariensis Steindachner, Sitzb. Akad. Wiss. Wien, vol. 96, pt. 1, p. 61, pl. 2, fig. 1, 1887 (type locality: Madagascar).

Callyodon madagascariensis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 11, pl. 44,J, 1956 (East Africa north of lat. 14° S., Aldabra, Seychelles).

This species is close to *S. niger* Forskål, and is characterized by having 7 median predorsal scales, 3 rows of scales on the cheek, with 3 to 5 scales in the ventral (third) row; ii,12 pectoral fin rays; green teeth; a coloration of dark brown with numerous horizontal violet

brown streaks on sides; lower posterior side of head with numerous pale spots (green when alive); upper lip broadly pale at edge; lower lip narrowly pale at edge, followed posteriorly by green bars; second green bar on chin extends to corner of mouth thence to lower edge of eye. Its color pattern is similar to that of *Scarops rubroviolaceous*.

I have seen only two specimens of this species, but Smith (loc. cit.) reports it to be abundant in the Western Indian Ocean.

Scarus blochi Cuvier and Valenciennes

PLATE 19,A

Scarus blochi Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 219, 1839 (type locality: Java).

Scarus quoyi (in part) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 273, 1839 (type locality: New Ireland; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 579).

Pseudoscarus viridis (not of Bonnaterre) Bleeker, Atlas ichthyologique . . . , vol. 1, p. 45, pl. 17, fig. 3, 1862.

Scarus chrysopomus Bleeker, Natuur- en Geneesk. Arch. Neêrl.-Indië, vol 4, pt. 2, p. 163, 1847 (type locality: Batavia; 2 cotypes examined in Mus. Nat. Hist. Nat. Paris, Cat. Nos. 1739 and 1760: 2 cotypes examined in British Museum, Cat. Nos. 1861.2.28.38, standard length 190 mm., and 1862.2.28.5, standard length 152 mm.).

Psuedoscarus chrysopoma, Day, Fishes of India, vol. 2, p. 412, pl. 89, fig. 2, 1878 (India: specimens from Andamans examined, (drawn) in Indian Musuem, Cat. Nos. 1666 and 1667).

Pseudoscarus rivulatus, Day, Fishes of India, vol. 2, 413 (not pl. 87 fig. 6), 1878 (Batavia, Java; specimen examined in Indian Museum, Cat. No. 1668).

Callyodon philippinus Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 70, p. 66, fig. 26, 1918 (type locality: Philippines).

Callyodon hadji Seale, Philippine Journ. Sci., vol. 4, No. 6, p. 525, 1909 (type locality: Palawan).

This species is characterized by having 6 median predorsal scales, 3 rows of scales on the cheek; white or yellowish teeth; the edges of dorsal and anal fins blue with basal ¾ of anal reddish brown, basal ⅓ of dorsal orange; anterior edges of paired fins blue, with a red stripe below upper blue edge of pectoral fin and remainder of fin blue; posterodrosal part of head reddish brown; green or blue upper lip, this green continuing behind mouth to below eye; 2 or 3 short blue streaks behind eye, and one forward from middle front of eye; lower lip blue; under side of head orange, with narrow, somewhat reticulated blue streaks; background color of body greenish red dorsally, brownish red ventrally; peduncular area greenish; caudal fin edged with blue dorsally and ventrally, yellowish green posteriorly, basally bluish.

I have studied very many specimens in lots from the following localities: Philippine Islands, 47 lots, Java, 3; and New Guinea, 1.

Scarus aeruginosus Cuvier and Valenciennes

PLATES 3,A; 19,B

Scarus aeruginosus Cuvier and Valenciennes, Historie naturelle des poissons, vol. 14, p. 257, 1839 (type locality: Red Sea; type examined in Mus. Nat. Hist. Nat. Paris from Pondicherry; Leschenault).

Scarus lacerta Cuvier and Valencienes, Historie naturelle des poissons, vol. 14, p. 217, 1839 (type locality; Pondicherry).

Pseudoscarus aeruginosus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 40, pl. 17, fig. 2, 1862 (East Indies).—Streets, U. S. Nat. Mus. Bull, 7, p, 81, 1877 (Fanning Islands; USNM 19922).—Day, the Fishes of India, vol. 2, p. 412, pl. 89, fig. 3, 1878 (Andamans; specimens examined in Indian Museum, Cat. No. 1669).

Scarus bennetti Jordan and Evermann, Bull. U. S. Fish Comm., vol. 23 (1903), pt. 1, pl. 45, 1905 (Hawaiian Islands).

Scarus dubius (not of Bennett) Weber and de Beaufort, Fishes of the Indo-Australian Archipelago, vol. 7, p. 300, 1940.

Callyodon pindae J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 11, pl. 45,I, 1956 (type locality; Pinda, Mozambique).

Callyodon dubius J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 12, pl. 45,J, 1956 (along east coast of Africa from lat. 3° to 15° S.).

Callyodon malindiensis J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 13, pl. 45,H, 1956 (type locality: Malandi, east coast of Africa).

This species is characterized by having 5 or 6 median predorsal scales; 3 rows of scales on the cheek, with 1 to 3 scales in the ventral row; usually ii,12 pectoral rays; whitish teeth; and a plain brownish or grayish background coloration with usually 3 pale streaks, one on each scale row of belly. There is no black spot at base of pectoral fin.

The lips almost cover the whitish or olive teeth in some specimens whereas in others, notably in those 130 mm. and longer, they are considerably exposed, the inner lip joins the outer lip at the symphysis; from 0 to 2 canines on each jaw may occur at the corner of the mouth, these usually appearing at a length of 150 mm. or longer; distal margin of caudal fin rounded in young, becoming truncate, the outer rays becoming a little elongate at lengths greater than 100 mm.

In alcohol the background coloration is plain brownish or reddish brown; at lengths of about 150 mm. and longer, 3 or 4 light streaks, one on each scale row, occur on belly from breast to origin of anal fin, sometimes one or more of these light streaks continue as far as the caudal peduncle.

In live specimens, the background coloration is plain reddish brown; fins tinged with red; dorsal and anal fins darker along edges; iris yellow; and teeth white.

This species has been confused with several others, especially *sordidus* and *dubius* both of which have only 4 median predorsal scales. The 3 or 4 pale streaks on the belly caused Weber and de Beaufort to confuse this species with *S. dubius* Bennett. Actually

their *Callyodon dubius* is *S. aeruginosus* Cuvier and Valenciennes and their *S. hypselopterus* is *S. dubius* Bennett.

Smith (loc. cit.) described as new *C. malindiensis* on the basis of "a wide snout: the swollen snout is probably due to parasitic infection."

I have studied very many specimens in lots from the following localities: Fanning Island, 1 lot; Samoa, 7; Tahiti, 1, Gilbert Islands, 1; Marshall Islands, 3; Marianas, 6; Japan, 1; Okinawa, 1; China Coast, 1; Ifaluk Atoll, 1; Moluccas, 1; Formosa, 2; Philippines and vicinity 169; Celebes, 6; New Guinea, 4; Dutch East Indies, 4; Solomons, 1; and Mauritius, 1.

Scarus randalli, new species

FIGURE 20; PLATES 19,C; 27,A

Callyodon upolensis (not of Jordan and Seale) J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 11, pl. 41H,I, 1956 (East Africa from Lat. 14° S. north to Aldabra and Seychelles).

Holotype USNM 163388, Onotoa Atoll, ocean reef beyond surf, depth 15 feet, speared by John Randall, summer 1951, standard length 165 mm., total length 199 mm.

Paratypes USNM 163389, Onotoa Atoll, lagoon and ocean reef, depth 12 to 15 feet, speared by John Randall, summer 1951, 3 specimens, 138 to 168 mm.; USNM 163390, 163391, 163392, 163393, Canton Island, Feb. 4 to March 11, 1951, collected by N. C. Bunker and J. M. Bunker, 4 specimens, 151 to 210 mm; USNM 163395, Jarvis Island, Feb. 10, 1951, K. E. Groves, 1 specimen, 305 mm; USNM 163394, Palmyra Island, Coral heads, western end, April 23, 1953, B. Halstead and R. Bunker, 1 specimen, 245 mm.

The following paratypes were collected by the George Vanderbilt Foundation and are included through the courtesy of Dr. R. R. Harry. Ifaluk Atoll: Inner edge of reef-flat between Falarik and Elangalap Islets, Sept. 21, 1953, 2 specimens, 38.5 and 48 mm; reef-flat between Elangalap and Ella Islets, Oct. 23, 1953, 1 specimen, 67 mm.; reef-flat and coral heads north of Elangalap Islet, Oct. 28, 1953, 1 specimen, 58 mm. Kapingamarangi Atoll: Sakoro coral head (H. O. Chart 6042) in center of lagoon, June 26, 1954, 1 specimen, 220 mm. Palmyra Island: Outside reef, one fourth mile southeast of center of Sand Islet, Aug. 17, 1951, 10 specimens, 52 to 240 mm.; southwest of Sand Islet in deep water, Aug. 18, 1951, 4 specimens, 57 to 115 mm.

In addition to the types there are 2 specimens (in poor condition) from Kapingamarangi Atoll that I refer with doubt to this species. I do not consider them to be paratypes.

Precision measurements were made on the holotype and a paratype, and these are expressed in thousandths of the standard length, respectively. Standard lengths 165 and 305 mm. Length of head 340 and 338; greatest depth 340 and 318; length of snout 139 and 161; diameter of eye 64 and 54; fleshy interorbital space 121 and 115; postorbital length of head 155 and 154; least preorbital width 75 and 75; least depth of caudal peduncle 155 and 144; length of caudal peduncle 182 and 165. Length of longest dorsal spine 109 and 105; of soft dorsal ray 127 and 128; of anal spine 67 and 65; of soft anal ray 115 and 125; of pectoral 230 and 226; of pelvic 182 and 177; of caudal 255 and 236.

The following counts were recorded for holotype and all paratypes: Dorsal IX,10; anal III,9, pectoral ii,12, pelvics I,5, branched caudal rays 6 + 5. Additional counts are recorded in table 4.

Lips do not cover the whitish teeth; angle between upper and lower lips varies from 35 to 55 degrees; the inner upper lip joins the outer upper lip about equidistant between corner of mouth and symphysis; a canine tooth present on largest specimen at inner corner of upper jaw, but canines are absent on smaller specimens; distal margin of caudal fin slightly concave on smallest specimens, with outer rays a little elongate in larger ones.

In alcohol the background coloration is light grayish to light brown; a dark brown streak along center of each scale row, beginning with lateral line row, and continuing to belly, these prominent dark streaks separated by prominent pale streaks, both extending from behind head to caudal peduncle, latter paler than rest of body; median fins light brown; dorsal and anal fins narrowly edged with dusky; paired fins pale, dorsal rays of pectoral dusky; usually some of the scales under the appressed pectoral fin have a dark bar anteriorly. Some dusky or brownish streaks occur around mouth as illustrated in figure 20 (see p. 46). The lengthwise streaks on the largest specimen, 305 mm., have largely changed into a solid dark brown below lateral line, and the back, as in the smaller specimens, is light gray; caudal peduncle and caudal fin light gray or very light brown; scales on lower sides behind pectoral bases blackish anteriorly, pale posteriorly; fins not edged with dusky.

A specimen 46 mm. long has 7 black spots basally on dorsal fin and 3 black spots basally on anal fin; dorsal edge of caudal peduncle with 2 black dots, ventral edge with a pair of dots; a black spot each at dorsal edge and ventral edge of caudal fin base; pelvic fin with 2 black bars; at a standard length of 86 mm. these color marks have almost disappeared, but at a length of 67 mm. the peduncular region is white or pale and dorsal fin barred.

The following notes on the color when alive were made from a

Kodachrome transparency kindly furnished by John Randall, University of Hawaii: Back purplish gray, lower sides gray, tinged with yellowish; caudal peduncle light pink, caudal fin reddish; distal ¾ of dorsal and anal fins reddish, basal light blue; pectoral and pelvic fins reddish; teeth white, head reddish brown; iris orange; the lengthwise dark streaks purplish, the pale interspace olive gray.

The following color note was furnished by Dr. Randall: "Underwater this species appeared brown with markedly pale caudal peduncle. Out of water the body proved to be reddish brown and the fins bright red." The greenish tinge of the water probably accounts for the brownish color under water at a distance.

This species is characterized by having 6 or 7 median predorsal scales, three rows of scales on the cheek, with 3 (seldom 2) scales in the ventral row; ii,12 pectoral rays; and a color pattern of 5 dark lengthwise streaks alternating with pale interspaces on small adults, these dark streaks joining (in the large adult) to form nearly plain dark sides; especially noteworthy are the dark bars on the anterior belly scales.

Named in honor of John E. Randall, University of Hawaii, who collected the species at Onotoa Atoll, Gilbert Islands, and photographed the holotype in color (herein reproduced in black and white, pl. 19,c).

Scarus pectoralis Cuvier and Valenciennes

FIGURE 25; PLATE 19,D

Scarus pectoralis Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 269, 1839 (type locality: Djedda, Red Sea).

Scarus cyanognathos Bleeker, Verh. Bataviaasch Genootsch., vol. 12, p. 63, 1849 (type locality: Batavia, Java; cotype examined in British Museum, Cat. No. 1862.2.28.4, standard length 182 mm.).

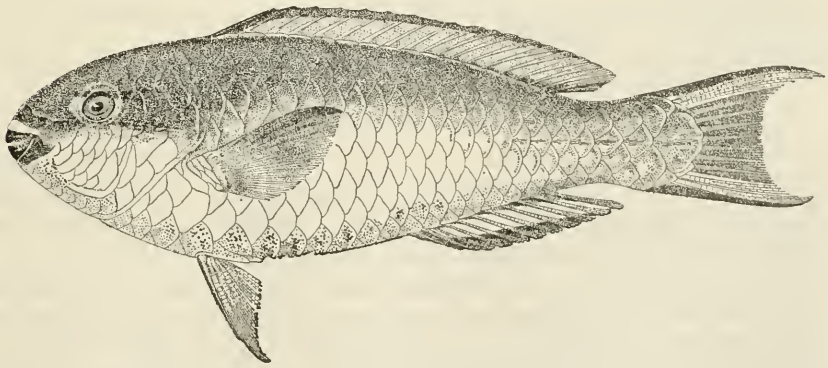


FIGURE 25.—*Scarus pectoralis*, after type of *Callyodon elerae* Jordan and Seale (Bull. U. S. Bur. Fish., vol. 26, p. 31, fig. 11, 1907).

Pseudoscarus cyanognathos Bleeker, Atlas ichthyologique . . ., vol. 1, p. 32, pl. 11, fig. 2, 1862.

Callyodon lazulinus Jordan and Seale, Bull., U. S. Bur. Fish., vol. 25, (1905), p. 333, fig. 65, 1906 (type locality: Apia and Pago Pago, Samoa; holotype USNM 51758; paratypes USNM 51826, 51832, and 51837).—J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 13, pl. 42,K, 1956, (western Indian Ocean south to lat. 15° S.).

Callyodon elerae Jordan and Seale, Bull., U. S. Bur. Fish., vol. 26, (1906), p. 31, fig. 11, 1907 (type locality: Cavite, Philippine Islands).

Pseudoscarus pectoralis Günther, Journ. Mus. Godeffroy, vol. 8, p. 324, pl. 158, 1909.

This species is characterized by its green teeth when adult; the dark coloration dorsoanteriorly, abrupty changing to pale below a horizontal line through lower edge of orbit; a blue streak, extending from middle of snout past lower edge of eye, that separates darker color above from yellowish color below; the body posteriorly abruptly pale behind base of dorsal spines VII or VIII; pectoral rays ii,12; 3 or 4 scales in ventral (third) row on cheek; anal fin broadly blue distally, pink basally; dorsal fin blue distally, broadly pink basally. This species resembles *S. oviceps* but lacks the 2 or 3 yellow bars on an otherwise dark back.

I have studied specimens in lots from the following localities: Philippines, 21 lots; Celebes, 1; Ifaluk Atoll, 1; and Dutch East Indies, 1.

Scarus dussumieri Cuvier and Valenciennes

PLATE 20A,B

Scarus dussumieri Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 252, 1839 (type locality: Seychelles; three types examined in Mus. Nat. Hist. Nat. Paris, one under Cat. No. 1719, from Zanzibar, and two under No. 1720 from the Seychelles).

Pseudoscarus dussumieri Bleeker, Atlas ichthyologique . . . , vol. 1, p. 46, pl. 8, fig. 1, 1862.

?Callyodon mus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 13, pl. 41, B, 1956 (type locality: Shimoni, East African Coast).

Callyodon speigleri J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 14, 1956 (type based on *Pseudoscarus dussumieri* Bleeker, pl. 8, fig. 1, 1862).

This species is characterized by having 6 median predorsal scales, 3 rows of scales on the cheek, the ventral (third) row with 1 to 3 scales (3 in figure of *C. mus* Smith); pectoral rays ii,12; teeth white; dorsal fin edged with blue distally and basally, the central ⅕ plain pink; anal fin similar but the central pink portion occupies ½ to ⅔ of fin.

The specimens from the tropical West Pacific have ii,12 pectoral rays in 16 counts whereas the three types of Cuvier and Valenciennes, have ii,13 pectoral rays in 5 counts and ii,12 in another. This may indicate a subspecific difference between the western Indian Ocean and the West Pacific, but we lack sufficient specimens to establish in well substantiated detail the differences between them.

I have studied specimens in lots from the following localities: Phoenix Islands, 4 lots; Philippines, 5; Bonin Island, 1; and Persian Gulf, 2.

KEY TO THE SPECIES OF SCARUS OF THE ATLANTIC

1*a*. Four rows of scales on the cheek, with from 2 to 4 in the ventral row; pectoral rays ii,12, rarely ii,13; canines present or absent in adults; figure 26 and plate 20,C. (West Atlantic.) . . . . . **vetula** Bloch and Schneider

1*b*. Three rows of scales on the cheek, the ventral row may be represented by 1 scale (rarely missing on one side) or as many as 5 scales.

2*a*. Pectoral rays usually ii,13 or ii,14; canines usually absent in adults.

3*a*. Pectoral rays usually ii,14; third, or ventral, row of scales on cheek with 1 scale occasionally 2 scales; in adults margins of lips pale with brownish submarginally; coloration plain dusky to light brownish, with narrow margins of dorsal and anal fins dusky (green when alive) or same color as rest of fin (in alcohol); figure 27 and plate 20,D. (West and East Atlantic.) . . . **guacamaia** Cuvier

3*b*. Pectoral rays ii,13 or ii,14; (see table 5) usually 1 scale, occasionally 2, in third, or ventral, row on cheek; in adults narrow edges of both lips brown, thence submarginally pale (blue or blue-green when alive), then on lower jaw a brown crossbar; scales on cheeks blackish or brown, naked areas green; distal edges of dorsal and anal fins distinctly pale in alcohol (bright blue or green when alive); outer edges of caudal and pelvic fins blue; general background color of body and fins brownish; plate 21,B. (West Atlantic.) **coelestinus** Cuvier and Valenciennes

3*c*. Pectoral rays ii,13; usually 2 scales in third, or ventral, row on cheek; young as well as adults usually with a hump on the snout; coloration usually uniform robin's-egg blue when alive, occasionally inconspicuous green stripes on snout, the latter blue-green; distal edges of dorsal and anal fins blue-green, rest of fin light pink; outer edges of paired fins and caudal fin blue-green; greatest depth about 2.7 to 3.1, plates 21,A, 22,A. (West Atlantic.) . . **coeruleus** (Bloch)

2*b*. Pectoral rays ii,12, rarely ii,13 on one side.

4*a*. Coloration usually consisting of a pattern of light and dark stripes or bands on sides and upper sides; 3 sharp or narrow white or dark streaks, one each on the middle of the 3 lower rows of scales on abdomen; anal fin plain in color, without a median streak; immature and females; plate 27,C. (West Atlantic, Bermuda.) **croicensis** Bloch

4*b*. Coloration not as above.

5*a*. Coloration of anal fin consists of two parallel brown lines, separated by a pale interspace, across its middle third, with a series of brown (blue when alive) spots in pale interspace; opercular flap usually brownish; a broad band behind head pale; adult males (formerly known under the name *punctulatus* Cuvier and Valenciennes); plate 21,C. (West Atlantic.) . . . . **croicensis** Bloch

5*b*. Coloration of anal fin consists of a pale basal half and a dark distal half; a dark streak from eye across operculum toward pectoral base, the latter dark; two pale streaks across snout; plate 21,D. (East Atlantic.) . . . . . **hoefleri** (Steindachner)

TABLE 5.—*Counts recorded for certain species of the subgenus* Hemistoma *of the genus* Scarus *from the Atlantic Ocean*

Species	Scale rows on cheek		median pre-dorsal scales				Scales in each row on cheek																				Pectoral fin rays				
							dorsal row				second row						third row										fourth row						
	3	4	5	6	7	8	5	6	7	8	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	2	3	4	ii,11	ii,12	ii,13	ii,14	ii,15
guacamaia	38	—	—	22	—	—	18	12	—	—	1	13	15	1	—	—	1	25	6	—	—	—	—	—	—	—	—	—	—	—	—	—	86	—
coelestinus	9	—	1	5	—	—	3	7	3	—	—	1	9	3	—	—	1	9	3	—	—	—	—	—	—	—	—	—	—	—	—	6	6	1
coeruleus	31	—	—	21	1	—	3	32	—	—	3	22	10	—	—	—	—	3	32	—	—	—	—	—	—	—	—	—	—	—	1	32	—	—
croicensis	32	—	—	2	22	—	2	24	5	1	—	2	16	11	3	—	—	—	20	12	3	—	—	—	—	—	—	—	—	2	69	3	—	—
croicensis (=punctulatus[1]*)*	52	—	—	3	30	1	3	35	15	—	—	4	24	19	6	—	—	2	32	11	8	2	—	—	—	—	—	—	—	1	60	2	—	—
hoefleri	3	—	—	—	3	—	—	—	4	1	—	1	4	—	—	—	—	—	4	1	—	—	—	—	—	—	—	—	—	—	5	—	—	—
vetula	—	24	—	—	14	—	—	1	21	2	—	—	3	9	9	3	—	—	—	—	—	1	5	12	5	1	1	10	13	—	26	2	—	—

[1]This "species" represents the mature male of *S. croicensis* (see p. 107)

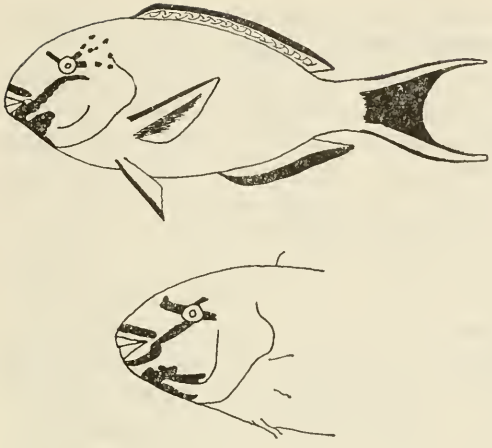


FIGURE 26.—*Scarus vetula*, adult males. (Sketches by author.)

FIGURE 27.—*Scarus guacamaia*. (Sketch by author.)

Scarus vetula Bloch and Schneider

FIGURE 26; PLATE 20,c

Scarus vetula Bloch and Schneider, Systema ichthyologiae . . . , p. 289, 1801 (based on pl. 28, fig. 1, of Parra 1787).—Evermann and Marsh, Bull. U. S. Fish Comm., vol. 20 (1900), pl. 31, 1902 (Puerto Rico).—Winn and Bardach, Science, vol. 125, pp. 885–886, 1957.

Scarus acutus Poey, Memorias . . . , vol. 2, p. 216, 1860 (type locality: Havana).

Scarus superbus Poey, Memorias . . . , vol. 2, p. 218, 1860 (type locality: Cuba).

Pseudoscarus gnathodus Poey, Repertorio . . . , vol. 2, p. 240, 1867 (type locality: Havana).

Scarus cuzamilae Bean, Bull. U. S. Fish. Comm., vol. 8 (1888) p. 196, pl. 29, fig. 4, 1890 (type locality: Cozumel, Yucatán; Holotype USNM 37128).

Scarus nigrescens Meek and Hildebrand, Marine fishes of Panama, vol. 3, p. 743, pl. 72, fig. 2, 1928 (type locality: Porto Bello, Panama; holotype USNM 81764).

This species is characterized by having 7 median predorsal scales, 4 rows of scales on the cheek, with 3 or 4 scales in the ventral (fourth) row, a character not yet found for any other species of Scaridae; ii,12, occasionally ii,13 pectoral rays. As many as 3 well developed canine teeth may occur at the corner of the upper jaw of adults; these are lacking on the immature.

Specimens smaller than 180 mm. in standard length may have a striped color phase in which head and body is brown above midlengthwise axis of body, with a pale streak just below lateral line; pale area below eye, extending posteriorly as a pale streak along midside of body.

Those longer than 180 mm. in standard length may have a broad pale band posteriorly on sides, below which is a dark brown streak

about 2 scales wide; these are believed to be mature females; larger adults have streaks on the head as shown in figure 26.

At lengths of 40 to 100 mm. in standard length the color pattern is plain brownish and the dorsal and anal fins are narrowly edged with a dark line, whereas the caudal fin distally is edged with white.

A specimen, 240 mm. in standard length, immature male from Bermuda, collected by Dr. Winn, was grayish with green fins when alive. The distal half of anal was green, basal half pink; middle rays of caudal fin green, outer rays dorsally and ventrally pink; pectoral and pelvics pink; lower lip with very narrow pink edge, submarginally a green streak that extends to below eye then pink, followed by a broad green band across ventral part of head. The 355-mm. specimen is a mature male, bright green, with color pattern as shown in figure 26.

I have examined numerous specimens in lots in the national collection from the following localities: Florida, 2 lots; Cuba, 1; Bermuda, 3; Cozumel, 1; Panama, 1; St. Lucia, 1; Barbados, 1; St. Thomas, 1; and West Indies, 1; also 1 specimen from Bermuda, loaned by the Chicago Natural History Museum; 4 specimens from Bermuda, collected by Dr. Winn; and 5 lots from the Bahama Islands, loaned by Dr. Böhlke.

Scarus guacamaia Cuvier

FIGURE 27; PLATE 20,D

Scarus guacamaia Cuvier, Règne animal . . . , ed. 2, vol. 2, p. 265, 1829 (based on Parra, 1787, pl. 26; no description).—Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 178, 1839 (St. Thomas).

Scarus turchesius Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 181, 1839 (type locality: Puerto Rico).

Scarus pleianus Poey, Memorias . . . , vol. 2, p. 393, 1861 (based on *S. guacamaia* Cuvier and Valenciennes).

This species is characterized by having ii,14 pectoral fin rays; 6 median predorsal scales, 3 rows of scales on the cheek, usually with 1 scale (sometimes 2) in the ventral row; and green teeth in the adult, canine teeth seldom present at rear of jaws. *S. guacamaia* is close to *S. coelestinus* but differs in color pattern. Further verification is needed because these differences might represent sexual dichromatism. I do not have specimens sufficiently well preserved to determine sex.

In alcohol, the narrow distal margins of the dorsal and anal fins are dusky (green when alive) or the same color as rest of fin; and the margins of lips are pale (red when alive); submarginally a dusky (green when alive) streak crosses snout to lower front of eye and another such streak extends across middle of chin towards corner of mouth, sometimes interrupted there, thence to lower edge of eye; teeth green. The teeth of this species begin to turn green at about 60 mm. in standard length.

I have not seen specimens from the East Atlantic, but I have examined numerous lots in the national collections from the following localities: Florida, 23 lots; Bermuda, 1; Panama, 2; Jamaica, 1; Curacao, 2; Haiti, 1; St. Thomas, 1; and Bahia, Brazil, 2; also 5 lots from Bermuda, loaned by the Chicago Natural History Museum; and 3 from the Bahamas, loaned by Dr. Böhlke.

Scarus coelestinus Cuvier and Valenciennes

PLATE 21,B

Scarus coelestinus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 180, 1839 (type locality: St. Thomas).

Scarus rostratus Poey, Memorias . . . , vol. 2, p. 221, 1860 (type locality: Cuba).

Pseudoscarus simplex Poey, Repertorio . . . , vol. 1, p. 185, 1865 (type locality: Punta de Maya, Matanzas, Cuba).

Pseudoscarus plumbeus Bean, Proc. Biol. Soc. Washington, vol. 25, p. 125, 1912 (type locality: Bermuda).

This species is characterized by having ii,13 to ii,15, usually ii,13 or 14 pectoral fin rays; 5 or 6 median predorsal scales, 3 rows of scales on the cheek with 1 or 2 scales in the ventral row; and green teeth in the adult. It is so close to *S. guacamaia* that most authors do not recognize it as a distinct species. The scales on the cheeks are blackish or dark brown and the naked area around them is green or blue-green; distal edges of dorsal and anal fins bright blue-green or green, pale in alcohol, remainder of fin brownish green; background color dark green, with edges of scales dark reddish brown; pectoral fin dark brown, with dorsal edge green; edge of lips brown or dusky, then submarginally green; middle of chin with brown bar; dorsal surface of snout with large dark-brown squarish blotch.

The color pattern of *S. coelestinus*, in alcohol, has white distal margins on dorsal and anal fins, sharply contrasting with a dark-brown body; edges of both lips are brown, then pale submarginally, canine teeth at rear sides of jaws seldom present. Longley and Hildebrand (1941, p. 221) describe the color of live specimens as follows: Slate color above, ashy gray on sides and belly; most scales with light blue marks in center, larger and more intensely blue on sides; dorsal, anal, anterior margin of pelvic and posterior margin of caudal fins edged with bright blue; jaws dark blue, narrowly white on cutting edge; lips narrowly dark-margined, snout and throat light blue, with a slate-colored strap under chin; irregular blue markings on occipital region. Parr's (Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, p. 110, 1927) description of the color of live specimens are as follows: General coloration of fins deep brownish black, leaving only narrow blue distal margins on dorsal and anal fins; blue anterior rays of pelvics and upper rays of pectorals; and narrow, blue, upper and lower edges on caudal. Bright blue spots on some of the horizontal

series of scales anteriorly on body; cheeks framed in bright blue, with brownish black central part; lips and throat blue; brownish black vertical band separating blue of lower lip from anterior blue border of cheek; two transverse blue bars above eyes and two median blue spots on nape.

I have examined 6 large specimens of this species from Florida, Jamaica, St. Thomas, and Cuba.

Scarus coeruleus (Bloch)

PLATES 21,A; 22,A

Corphyaena coerulea Bloch, Naturgeschichte der ausländischen Fische, vol. 2, p. 148, pl. 176, 1786 (in part after Catesby 1731, altered from a figure by Plumier 1695; Bloch's figure is scarcely recognizable as a parrotfish).

Scarus coeruleus Bloch and Schneider, Systema ichthyologiae . . . , p. 288, 1801 (after Catesby 1731 and *Trompa* of Parra 1787).—Evermann and Marsh, Bull. U. S. Fish Comm., vol. 20 (1900), p. 244, pl. 32, 1902 (Puerto Rico).

Scarus loro Bloch and Schneider, Systema ichthyologiae . . . , p. 288, 1801 (based on *Loro* of Parra 1787).

Scarus trilobatus Lacépède, Histoire naturelle des poissons, vol. 4, pp. 5, 21, 1803 (type locality: Martinique; based on drawing by Plumier 1695).

Sparus holocyaneos Lacépède, Histoire naturelle des poissons, vol. 4, pp. 45, 141, 1803 (type locality: Martinique; based on a drawing by Plumier 1695).

Scarus obtusus Poey, Memorias . . . , vol. 2, p. 217, 1860 (type locality: Cuba).

Scarus nuchalis Poey Memorias . . . , vol. 2, p. 220, 1860 (type locality: Cuba).

This species is characterized by having 6 median predorsal scales; ii,13 pectoral rays; on the cheek usually 2 scales in ventral (third) row; on the snout a big hump (on adults); usually a uniform robin's-egg blue, washed with yellowish on the occiput, and sometimes inconspicuous stripes. It is one of the more slender species, the greatest depth is contained 2.7 to 3.1 in the standard length.

I have examined numerous specimens of this species in lots from the following localities: Florida, 5 lots; Cuba, 3; Haiti, 2; Bahamas, 1; Puerto Rico, 3; Jamaica, 2; Barbados, 1; Panama, 2; and West Indies, 1; and 3 lots from the Bahamas loaned by Dr. Böhlke.

Scarus croicensis Bloch

PLATES 21,C; 27,C

Scarus croicensis Bloch, Naturgeschichte der Ausländischen Fische, vol. 4, p. 27, pl. 221, 1790 (type locality: St. Croix).—Winn and Bardach, Science, vol. 125, pp. 185–186, 1957.

Scarus insulae st. crucis Bloch and Schneider, Systema ichthyologiae . . . , p. 285, 1801 (type locality: St. Croix; based on Bloch).

Calliodon lineatus Bloch and Schneider, Systema ichthyologiae . . . , p. 312, pl. 62, fig. 2, 1801 (after Gronow).

Scarus alternans Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 200, 1839 (type locality: Martinique).

Scarus punctulatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 195, 1839 (type locality: Martinique).

Scarus taeniopterus Desmarest *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 195, 1839 (type locality: Cuba; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1750; no color remains).

Scarus diadema Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 198, 1839 (type locality: Martinique; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1747).

Scarus flavomarginatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 202, 1839 (type locality: Martinique; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1746, 125 mm. standard length).

Psuedoscarus taeniopterus Günther (not of Desmarest), Catalogue of the fishes in the British Museum . . . , vol. 4, p. 226, 1862 (Trinidad).

Scarus aracanga Günther (not of Günther 1862, p. 227), Catalogue of the fishes in the British Museum . . . , vol. 4, p. 209, 1862 (type locality: Jamaica).

Psuedoscarus aracanga Günther (not of Günther 1862, p. 209) Catalogue of the fishes in the British Museum . . . , vol. 4, p. 227, 1862 (type locality: Jamaica; type examined in British Museum, 1933.2.20.1, standard length 145 mm.; pectoral rays ii,12).

Scarus virginalis Jordan and Swain, Proc. U. S. Nat. Mus., vol. 7, p. 88, 1884 (type locality: Havana, Cuba; holotype USNM 35080).

Scarus bollmani Jordan and Evermann, Proc. U. S. Nat. Mus., vol. 9, p. 470, 1886 (type locality: Snapper Banks off Pensacola, Florida; holotype USNM 37993).

Scarus evermanni Jordan *in* Jordan and Evermann, Proc. U. S. Nat. Mus., vol. 9, p. 469, 1886 (type locality: Snapper Banks off Pensacola, Florida; holotype USNM 37990).

Scarus emblematicus Jordan and Rutter, Proc. Acad. Nat. Sci. Philadelphia p. 122, 1897 (type locality: Kingston, Jamaica).—Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 3, p. 1654, pl. 245, fig. 614, 1900).

Pseudoscarus lineolatus Poey, Repertorio . . . , vol. 2, p. 239, 1867 (type locality: Cuba).

Callyodon margarita Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 133, fig., 1917 (type locality: Colón, Panamá).

Sparisoma distinctum (not of Poey) Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 102, p. 75, fig. 8, 1950 (Cuba).

This species is characterized by having 3 rows of scales on cheek, ventral (third) row with 1 to 5 scales (usually 2 or 3); median predorsal scales usually 7; pectoral rays usually ii,12.

In adult male, coloration of anal fin is characteristic, consisting of two parallel brown lines separated by a pale interspace across middle third of fin, with a brownish spot on membrane between each ray, in center of interspace; opercular flap usually brownish.

Longley (*in* Longley and Hildebrand, 1941, p. 217) states that on live specimens the spots on anal fin are blue; and that on swimming fish he has observed a green stripe running horizontally from upper angle of opercle to dorsal margin of orbit, thence forward to meet similar stripe on opposite side, and continued posteriorly, from opercle to base of caudal; a second stripe similar and parallel extending from

below posterior angle of opercle beneath eye to angle of mouth, there dividing into branches following upper and lower lips; this stripe sometimes carried backward on body, if lower stripe is not well developed, a notable red patch, reaching to vertical line through vent, present on side above pectoral fin; if stripe is distinct, the red patch, split lengthwise, is largely suppressed, and dorsal ocular, and pectoral dark stripes separated by light stripes are present. This species may have a blotched color phase too.

In immature and female, color pattern is characterized by having distinct light and dark stripes on sides of body. In small young there are 3 alternating sharp narrow white and dark streaks on the side, one along back, one behind eye, and one through upper part of pectoral fin base, the last two extend all the way to the base of the caudal fin. The dark streaks on body may be prominent in some individuals up to about 80 mm. in standard length. The color pattern of white and dark streaks will identify this species down to at least 12 mm. in standard length, but the caudal fin is plain white in specimens smaller than 30 mm.

It was observed during this study that all anatomical details of specimens referable to *S. croicensis* and to *S. punctulatus* were exactly the same, especially in the counts recorded (see table 5). Not until the autumn of 1956 was it possible to conclude without further doubt that *S. croicensis* represented the immature and females of a species and that *S. punctulatus* was the mature male. Dr. James Böhlke, Academy of Natural Sciences of Philadelphia, loaned to me a large series of this species, recently collected in the Bahamas. From that material it was possible to trace the development of the *punctulatus* color pattern from that of the immature, between standard lengths of 75 to 102 mm. In addition Dr. Howard Winn, University of Maryland, and Dr. John E. Bardach, University of Michigan, while at Bermuda in the summer of 1956, injected male hormone (testosterone) into individual female *croicensis*. In a short time, the male *punctulatus* color pattern developed. I have seen their specimens.

The most intensely colored dark streak or band is along midside of body, and this remains visible even though blended with the general coloration. At about 75 mm. the dark crossbars on underside of head appear and become more fully developed in the *punctulatus* pattern, along with the characteristic lines and spots on anal and dorsal fins; in a specimen 102 mm. in standard length, the *croicensis* color pattern is partially retained in the *punctulatus* color pattern as regards the dark band through orbit and the whitish ventral part of body adjoining anal fin base.

In the list of synonyms above, *croicensis*, *insulae st. crucis*, *lineatus*,

alternatus, *evermanni*, *emblematicus*, *lineolatus*, *margarita*, and *distinctum*, represent the immature or female color pattern; all other species names represent adult males.

I have examined numerous lots from the following localities: Florida, 45 lots; Bermuda, 4; Bahamas, 5; Cuba, 8; Puerto Rico, 2; Haiti, 6; Curacao, 3; St. Lucia, 1; Nassau, 1, St. Thomas, 1; West Indies, 1; Texas, 1; Cozumel, 1; and Panama, 11; also 35 lots from Bermuda, loaned by the Chicago Natural History Museum; and 26 lots from the Bahamas, loaned by Dr. Böhlke.

Scarus hoefleri (Steindachner)

PLATE 21,D

Pseudoscarus hoefleri Steindachner, Denkschr. Akad. Wiss. Wien, vol. 44, p. 46, pl. 6, fig. 2, 1881 (type locality: Gorée (Dakar), West Africa).

In alcohol, this species is brownish, including all median fins; posteroventrally paler adjacent to anal fin base; teeth in young whitish, becoming grayish green in a specimen 195 mm. in standard length.

I have examined 2 specimens from off Monrovia, Liberia, collected by George C. Miller, U. S. Fish and Wildlife Service.

Subfamily Sparisomatinae

This subfamily is characterized by having the teeth incompletely coalesced into 4 plates, sometimes with pointed incisorlike teeth externally on the platelike structures; one row of scales with 2 to 4 scales on the cheek below eye; upper pharyngeal bones each with 3 rows of teeth; lower pharyngeal bone with dentigerous surface notably broader than long; number of teeth in middle rows of lower pharyngeals vary from 6 to 7 counting all rudiments; anterior nostril with a distinct cirrus, or dermal flap; lateral line interrupted below rear end of base of dorsal fin, then beginning again one row lower and continuing along midside of caudal peduncle; gill rakers 2 or 3+1+6 to 12; pectoral rays normally ii,11; dorsal spines flexible or pungent; median predorsal scales 4 or 5; abdominal vertebrae 9, caudal 16.

Genus Scaridea Jenkins

Scaridea Jenkins, Bull. U. S. Fish Comm., vol. 22 (1902), p. 468, 1903 (genotype: *Scaridea zonarcha* Jenkins).

This genus is known only from the Hawaiian Islands.

Scaridea zonarcha Jenkins

PLATE 22,B

Scaridea zonarcha Jenkins, Bull. U. S. Fish Comm., vol. 22 (1902), p. 468, fig. 26, 1903 (type locality: Honolulu; USNW 50851).

Scaridea balia Jenkins, Bull. U. S. Fish Comm., vol. 22 (1902), p. 469, fig. 27, 1903 (type locality: Honolulu; holotype USNM 50582).

Scaridea aerosa Jordan and Snyder, Bull. U. S. Bur. Fish., vol. 26 (1906), p. 215, fig. 4, 1907 (type locality: Honolulu; holotype USNM 57786).

Scaridea farrandi E. K. Jordan, Proc. U. S. Nat. Mus., vol. 66, p. 28, pl. 1, fig. 4, 1925 (type locality: Honolulu; holotype USNM 87416).

The type specimen of *S. balia* has the pelvic fins farther forward as a result of the abdominal cavity being greatly swollen from gas pressure, in which abnormal shape the specimen was preserved.

I have studied 5 lots from the Hawaiian Islands.

Genus Sparisoma Swainson

Sparisoma Swainson, Natural history and classification of fishes . . . , vol. 2, pp. 172, 227, 1831 (genotype: *Sparus abildgaardi* Bloch's pl. 259).

Callyodontichthys Bleeker, Atlas ichthyologique . . . , vol. 1, pp. 5, 15, 1861 (no species listed).

Callyodontichthys Steindachner, Ichthyologische Mittheilungen V, Verh. Zool.-Bot. Ges. Wien, p. 1111 (or reprint p. 1), 1863, (genotype, *Callyodontichthys bleekeri* Steindachner=*Callyodon flavescens* (not of Bloch and Schneider) Cuvier and Valenciennes=*Scarus radians* Cuvier and Valenciennes).

The genus Sparisoma is characterized by having 3 rows of teeth on each upper pharyngeal bone, 1 row of scales on the cheek, 4 median predorsal scales, gill membranes broadly joined to isthmus without a free fold, pungent dorsal fin spines, teeth coalesced into parrotlike beak without external incisorlike teeth, and the lower jaw closing over tips of upper jaw; pectoral fin rays normally ii,11.

This genus has been recorded from localities in the West Atlantic from Florida and the Bahamas southward to Brazil, from Bermuda, and from the East Atlantic (3 species), but I cannot verify any of these East Atlantic records.

Dr. Böhlke, Academy of Natural Sciences of Philadelphia, loaned me all his Bahamas collections, which were rich in specimens of *Sparisoma*.

KEY TO THE SPECIES OF THE GENUS SPARISOMA

1*a*. Prominent canine teeth occurring on upper dental plate at standard lengths shorter than 156 mm., the posteriormost canine appearing at lengths as short as 25 mm.; 4 outwardly projecting canines are usually developed at a length of 60 mm. and these may be placed on a slight ridge on dental plate; anterior nasal tentacle, simple, without multifid cirri; dorsal surface of head brown speckled; distance from suture between upper dental plates to canine tooth on midside contained 2½ to 3 times in distance between centers of posterior nasal pores; cirri occur on membranes of spiny dorsal fin just behind tips of spines; base of caudal fin without a broad white crossbar; base of pelvic fins of young with a distinct dark crossbar; depth 2.5 to 2.7 in standard length; caudal fin

rounded; size probably not exceeding 160 mm. in standard length; plate 22,c, D. (East and West Atlantic.)

radians (Cuvier and Valenciennes)

1*b*. A single prominent canine tooth may occur near midside of upper dental plate in combination with a broad white bar in basal third of caudal fin; distance from suture between upper dental plates to canine tooth is contained from 1.9 to 2.3 times in distance between centers of posterior nasal pores; at standard length of 80 mm. and longer cirri develop on nasal tentacle; no cirri on membranes of spiny dorsal fin; depth of body about 2.4 to 2.5 in standard length; no dark bar on pelvic fins (young).

abilgaardi (Bloch)

1*c*. If a canine tooth is present on side of upper dental plate at a standard length of 160 mm. or shorter, it is notably behind middle of side of dental

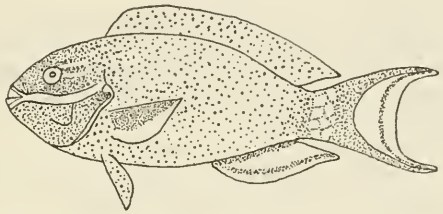


FIGURE 28.—*Sparisoma viridis*. (Sketch by author.)

plate, and not on a ridge; usually canines do not develop until larger sizes are reached, except in *abilgaardi*.

2*a*. Opercular flap with a round white spot (yellow when alive); posterior edge of opercle white (red when alive); caudal fin deeply forked, with a lunate white (red when alive) bar submarginally and distal edge green; on base of caudal fin and on peduncle 1 to 3 large pale spots (orange or yellow when alive); a pale streak (red when alive) bounded by green from corner of mouth across cheek; no dark pectoral spot; (above description appears to be that of males; females probably lack white opercular spot, but caudal fin is white-margined distally, then a dark submarginal crossbar, with center of fin white); figure 28. (West Atlantic.) ..... **viridis** (Bonnaterre)

2*b*. Color not as above.

3*a*. Small brown spots somewhat ocellate, occur on third or fourth scales behind head in row of scales just below lateral line; tips of outer caudal fin rays blackish; anterior nostril with a short dermal flap bearing multifid cirri distally; caudal fin truncate to deeply forked, distally in latter a lunate white area; dorsal base of pectoral fin dusky; a white streak extends from corner of mouth past lower

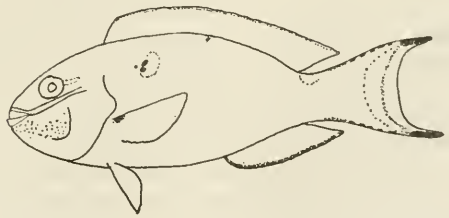


FIGURE 29.—*Sparisoma aureofrenatum*, male. (Sketch by author.)

edge of orbit, ending on naked area just behind eye; sometimes a white dash or spot occurs behind middle of eye; males; figure 29. (West Atlantic, Bermuda.)

aurofrenatum (Cuvier and Valenciennes)

3*b*. Color not as above.

4*a*. A white saddlelike spot on dorsal part of caudal peduncle just behind rear edge of dorsal fin base; base of pectoral fin brown; no brown shoulder spots; tips of caudal fin lobes pale, not dark colored; opercle with white (silvery) area; membranes just behind tips of dorsal spines without cirri, tip of dorsal spine ends in a cirrus; anterior nasal flap with a few cirri in adults; females, usually known as *distinctum* (Poey); figure 30. (West Atlantic, Bermuda.) . . . . . **aurofrenatum** (Cuvier and Valenciennes)

4*b*. Color not as above.

5*a*. Dorsal profile of head strongly rounded; interorbital space convex, anterior nasal tentacle very short, distally with multifid cirri that reach to or almost reach posterior nostril; membranes just behind tips of dorsal spines with multifid cirri, except on large adults of *S. axillaris*.

6*a*. Dorsal edge of pectoral base with a distinct dark brown saddlelike spot; pectoral fin brownish, except distal ⅓, which is pale or whitish; on large adults suture in upper dental plate

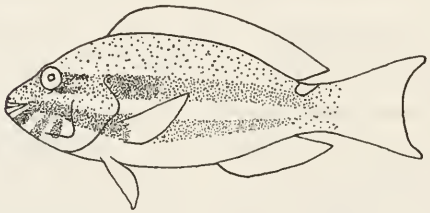


FIGURE 30.—*Sparisoma aureofrenatum* (=*distinctum*), female. (Sketch by author.)

with from a few to several short, interlocking, very small canine teeth externally, several other small caninelike teeth may project from sides of dental plates of upper jaw; distal edge of forked caudal fin with a lunate whitish mark, in large adults; plate 23,A. (West Atlantic, Bermuda.)

axillaris (Steindachner)

6*b*. No dark saddlelike spot on dorsal edge of pectoral base; pectoral base and pectoral fin plain in color or pale throughout its length; canine teeth, if present, not arranged as in *S. axillaris;* plate 23C,D. (East and West Atlantic.)

rubripinnis (Cuvier and Valenciennes)

5*b*. Interorbital space slightly concave, flattish to a little convex (more so in young); membranes just behind tips of dorsal spines usually without a cirrus, rarely 1 or 2 very small ones, usually tip of each dorsal spine ends in a simple cirrus.

7*a*. Dorsal edge of pectoral base with a saddlelike black or brown spot evident on specimens as short as 40 mm.; dorsal profile of head almost straight over orbits; the short anterior nasal

tentacle ribbonlike, with from 1 to 4 cirri distally; plates 4, B, and 23,B. (Probably occurs on both sides of the Atlantic.) **chrysopterum** (Bloch and Schneider)

7*b*. Pectoral base same color as remainder of that fin, no dark basal spot; dorsal profile slightly rounded over orbits; margins of scales dark brown, center of scales pale, several isolated ones white; rear edge of gill cover dark reddish-brown or blackish; caudal fin red, except basally; belly bloodred; head mottled brown and white; dermal flap of anterior nostril with multifid cirri in adults, more ribbonlike in young; plates 4,C, and 24A,B. (West Atlantic, Bermuda.) . . **abildgaardi** (Bloch)

Sparisoma radians (Cuvier and Valenciennes)

PLATE 22,C,D

Scarus radians Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14 p. 206, 1839 (type locality, Brazil; types examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1759, specimen 130 mm. in standard length).

Callyodontichthys bleekeri Steindachner, Ichthyologische Mittheilungen V, Verh. Zool.-Bot. Ges. Wien, p. 1111, pl. 24, figs. 2, 2, b, 1863 (type locality: Bahia, Brazil).

Scarus lacrimosus Poey Memorias . . . , vol. 2, p. 422, 1861 (type locality: Cuba).

Scarus atomarius Poey, Memorias . . . , vol. 2, p. 423, 1861 (type locality: Havana).

Scarus hoplomystax Cope, Trans. Amer. Philos. Soc., vol. 14, p. 462, 1871 (type locality: St. Martin, West Indies).

Sparisoma xystrodon Jordan and Swain, Proc. U. S. Nat. Mus., vol. 7, p. 99, 1884 (type locality: Key West, Florida; Holotype USNM 35174, was studied).

Sparisoma niphobles Jordan and Bollman, Proc. U. S. Nat. Mus., vol. 11, p. 551, 1888 (type locality: Green Turtle Cay, Bahamas; Holotype USNM 41734, studied).

Scaridea octodon Fowler, Fishes of Oceania, p. 368, fig. 59, 1928 (type locality, "Hawaiian Islands"; I examined the holotype, an old specimen without a readable label in the jar, which Fowler deduced came from the Hawaiian Islands. Without doubt the deduced locality is wrong, since the specimen is in all respects this species, of which I have studied a large series from the Western Atlantic).

Sparisoma cyanolene Jordan and Swain, Proc. U. S. Nat. Mus., vol. 7, p. 98, 1884 (type locality: Key West, Florida; 4 types studied, USNM 35173).

Sparisoma abbotti Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 67, p. 258, fig. 2, 1915 (type locality: St. Vincent Island, West Indies).

Like many other scarids, this species shows sexual dichromatism. Longley (*in* Longley and Hildebrand, 1941, p. 209) says that when alive, males have a dark-margined caudal fin, a narrow blue line with a red one behind it extending from angle of mouth to eye, and a blue (blackish in alcohol) pectoral base. I have observed that mature males may have the isthmus region dark purplish brown. Females have a light blue opercular margin.

This species is characterized by the development of 1 to 4 canines on each side of dental plate of upper jaw, the posterior canine being

the first to appear, at a standard length of about 25 mm., or shorter; in larger specimens (this never occurs in any other species of *Sparisoma*) these canines occupy a ridge on dental plate. It is a small species, the largest specimen observed by me measuring 156 mm. in standard length; the interorbital space is flattish to slightly convex; anterior nasal tentacle broad, simple, and reaches past posterior nostril; head dorsally speckled with brown; a pair of brown spots occur in interorbital space of the immature, and the distance between centers of nostrils is contained 2½ times in distance between this pair of brown spots; vertical line through anterior nostril passes through center of anterior scale on cheek; caudal fin rounded distally; cirri occur on membranes between dorsal spines, just behind tips of spines, appearing at about 40 mm. in standard length; a distinct dark bar occurs near base of pelvic fins on specimens shorter than 40 mm., making it possible to distinguish this species at about 18 mm. in standard length, before the canine teeth develop; between 25 and 40 mm. in standard length a somewhat striped color phase occurs in which 5 or 6 dark streaks are separated by narrower light streaks.

I have examined a large number of specimens in lots from the following localities: Southern Florida, 16 lots; Key West, 12; Tortugas Island 14; Florida Keys, 8; Bahama Islands, 3; Cuba, 12; Puerto Rico, 15; Haiti, 2; Jamaica, 1; St. Thomas, 2; St. Lucia, 2; Cozumel, 5; Old Providence Island, 1; Panama, 34; Colombia, 1; Curacao, 2; Bahia, Brazil, 2; 44 lots from Bermuda, loaned by Loren P. Woods, Chicago Natural History Museum and 24 lots from the Bahamas, loaned by Dr. Böhlke.

I have not seen a specimen from the East Atlantic.

Sparisoma viridis (Bonnaterre)

FIGURE 28

Scarus viridis Bonnaterre, *in* Encyclopédie méthodique, tableau encyclopédique et méthodique des trois règnes de la nature . . . , Ichthyologie, vol. 6, p. 96, pl. 50, fig. 193, 1788 (based on Catesby 1731; type locality: Bahamas).

Scarus catesby Lacépède, Histoire naturelle des poissons, vol. 4, pp. 4, 16, 1803 (based on Catesby 1731).

Scarus catesbaei Lacépède *in* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 183, 1839 (based on Catesby 1731).

Callyodon psittacus (not of Linnaeus) Gronow *in* Gray, Catalogue of fishes collected and described by L. T. Gronow, p. 84, 1854.

Scarus melanotis Bleeker, Versl. Akad. Amsterdam, vol. 14, p. 126, 1862 (type locality: St. Croix).

Sparisoma viride Winn and Bardach, Science, vol. 125, pp. 885–886, 1957.

This species is represented by specimens between 200 and 270 mm. in standard length in the national collections. I have not seen the young of *Sparisona viridis*.

The adult is characterized by a brownish color (green when alive); a pale or white spot (yellow when alive) at tip of opercle; posterior edge of operculum white (red when alive); base of caudal fin with 1 to 3 large pale spots (orange or yellow when alive); deeply forked caudal fin, with a lunate pale distal edge, submarginally dusky (green when alive) then another lunate white (red when alive) bar occupying central area of caudal fin; anterior nasal tentacle short, with only a few fine cirri on distal tip, not reaching to posterior nasal opening; usually 1 or 2 short canines on dental plate of upper jaw near rictus; body deep, depth contained about 2½ times in standard length, head not as long as depth of body; white band or streak from corner of mouth toward white opercular spot, passing notably below orbit; edge of upper lip white; a green band from snout below eye and including half of lower part of orbit; anal green distally, white in basal ⅔ except green spots at bases of fin ray.

Determination of sex in preserved specimens and the evidence accumulated by Dr. Howard Winn and Dr. John E. Bardach indicates that males are green with a white opercular spot. Dr. Böhlke's collection from the Bahamas contained one immature female, 154 mm. in standard length, with a trace of the white margin along opercular membrane, no white opercular spot; distal edge of caudal fin white, then a dark submarginal crossbar, with center of caudal fin white; a lighter area below eye on side of head at level of corner of mouth, upper lip whitish. This specimen may represent the female of *viridis*.

Longley says that specimens of this species appear most commonly in the brownish color phase, with red lines on the head, yellow spot at tip of opercle, and an orange one at base of caudal. It also has a spotted color phase.

Our 14 specimens are from Jamaica; St. Thomas; West Indies; Nassau; Puerto Rico; Haiti; Cuba; Tortugas Island, Florida; and Barbados. In addition, Dr. Böhlke loaned me a male specimen from New Providence Island and a female from Nassau Harbor, Bahamas.

Sparisoma aurofrenatum (Cuvier and Valenciennes)

FIGURES 29, 30

Scarus aurofrenatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 191, 1839 (type locality; San Domingo; types examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1770, San Domingo, standard length 138 and 142 mm.; also Cat. No. 1769, 4 specimens, standard length 148, 160, 165, and 180 mm.).

Scarus mineofrenatus Poey, Memorias . . . , vol. 2, pp. 379, 393, 1861 (substitute name for *S. aurofrenatus* Cuvier and Valenciennes).

Scarus distinctus Poey, Memorias . . . , vol. 2, p. 423, 1861 (type locality: Cuba).

Scarus frondosus (not of Cuvier) Günther, Catalogue of the fishes in the British Museum . . . , vol. 4, p. 210, 1862.

Scarus erythrinoides Guichenot, Mem. Soc. Sci. Nat. Cherbourg, vol. 11, p. 10, 1865 (type locality: San Domingo; two types examined in Mus. Nat. Hist. Nat. Paris, standard length 147 and 150 mm.).

Scarus oxybrachius Poey, Repertorio . . . , vol. 2, p. 342, 1868 (type locality, Havana).

Scarus festivus (nomen nudum) Longley, *in* Longley and Hildebrand, Pap. Tortugas Lab. Carnegie Inst. Washington, vol. 34, p. 208, 1941.

Sparisoma aurofrenatum Winn and Bardach, Science, vol. 125, pp. 185–186, 1957.

Mature males are characterized by a white streak from corner of mouth past lower edge of orbit, ending on naked area behind eye; sometimes a white spot or white dash just behind eye; a few very small brown spots on 3rd or 4th scales in scale row below lateral line, below or behind these scales may occur a white spot; tips of outer caudal fin rays blackish or brownish; 1 or 2 canine teeth on upper jaw, near corner of dental plate, develop at standard lengths of 150 mm. or longer; edges of anal and dorsal fins narrowly dusky; at standard length of 130 mm., caudal fin has a lunate white posterior border; dorsal base of pectoral dusky. At about 100 mm. in standard length the silvery opercular spot may disappear and the tips of each caudal fin lobe become darker or blackish, the white lunate-shaped area on caudal fin develops, and the entire base of pectoral fin becomes intense brown.

Color patterns of the immature and females are characterized by a white saddlelike spot on dorsal edge of caudal peduncle at rear edge of base of dorsal fin. This white spot varies greatly in intensity and may be absent; a silvery area or spot, which also may be indistinct, occurs on the middle of the opercle; at about 100 mm. and longer in standard length, a row of whitish scales occurs along base of dorsal fin; a fully mature female at 125 mm. is plain dark brown with scarcely a trace of the white peduncular spot.

Specimens about 80 mm. and shorter have from upper edge of opercular opening along midsides a broad dark band, the first three or four scales of which are intensely dark brown; just below the dark band is a much narrower whitish streak, in line with which is the silvery opercular spot.

In both sexes the shoulder area under the opercular apparatus is plain blackish or dark brown, the white gland dorsally sharply contrasting with the black around it. The usual brown crossbars on underside of head occur much as in other species of *Sparisoma*.

In the synomy above, *S. aurofrenatum* and *S. mineofrenatum* represent males, all other scientific names, the females.

A large series of specimens recently collected by Dr. James Böhlke in the Bahamas, together with experimental evidence obtained in 1956 at Bermuda by Dr. Howard Winn and Dr. John E. Bardach, indicates

beyond doubt that *Sparisoma aurofrenatum* represents the adult male and *S. distinctum* the female.

The immature of both sexes have the female color pattern, and at about 75 to 105 mm. in standard length, the male color pattern emerges. The development of the male color pattern from that of the immature and female appears to occur in several species of parrotfishes. Phylogenetically, I conclude that the immature and female color pattern is the basic one and that the male color pattern is of more recent origin.

Longley (in Longley and Hildebrand, 1941, p. 211) has observed three color phases: plain; striped; and mottled except for the red and yellow opercular spot, the dark humeral spot, and black tipped caudal lobes.

This species is anatomically characterized by having a flattish interorbital space (slightly convex in young); the anterior nasal tentacle is ribbonlike without cirri in specimens shorter than 40 mm., but cirri develop at larger sizes and the largest specimens have several cirri; membranes behind tips of dorsal spines are without cirri; canine teeth occur on adults but are absent on the immature; and distal margin of caudal fin rounded in young, becoming concave in adult.

I have studied numerous specimens from the following localities: Biscayne Bay, Tortugas Island, Cape Florida and Key West, Florida; Bahama Island; Cuba; Cozumel, St. Lucia; Dominica; Puerto Rico; St. Thomas; West Indies; Nassau; and Haiti; also three specimens from Bermuda were loaned by the Chicago Natural History Museum; and Dr. Böhlke loaned many specimens in 23 lots from the Bahamas, making it possible to identify the development of the male color pattern from that of the immature and female.

Sparisoma axillaris (Steindachner)

PLATE 23,A

Scarus (*Scarus*) *axillaris* Steindachner, Sitzb. Akad. Wiss. Wien, vol. 77, April, p. 6, pl. 3, fig. 1, 1878 (type locality: probably Coast N. Australia; Steindachner expresses doubt that the type locality is North Australia and I am certain it is not because the genus is not represented in the Pacific, furthermore, Steindachner's figure is an accurate portrayal of this West Atlantic species).

Scarus spinidens (not of Quoy and Gaimard 1824) Guichenot, Mem. Soc. Sci. Nat. Cherbourg, vol. 11, p. 15, 1865 (type locality: Bahia, Brazil; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1763; preoccupied by *Scarus spinidens* Quoy and Gaimard).

Sparisoma rhomaleum Meek and Hildebrand, Marine fishes of Panama, vol. 15, pt. 3, p. 754, pl. 74, fig. 1, 1928 (type locality: Colón, Panama; holotype USNM 81777 and paratype USNM 80877).

Scarus brachyvarius (nomen nudum) Longley, *in* Longley and Hildebrand, Pap. Tortugas Lab. Carnegie Inst. Washington, vol. 34, p. 212, 1941 (Havana).

Members of this species, known only from large adults, may be recognized by the possession of numerous small canine teeth variously placed externally on the greenish dental plate of upper jaw, usually some of them at median suture and more or less interlocking; a black or dark brown saddlelike spot at base of dorsal half of pectoral fin; middle part of body may be paler than other parts; distal ⅓ of pectoral fin white or pale, basal ⅔ brownish; a lunate white area distally on caudal fin, may be faded in preserved specimens; under side of head, especially chin, may be brown barred. The interorbital space is convex; anterior nasal tentacle palmate, with multifid cirri; membraneous tip of dorsal fin spines with a few cirri.

Longley (*in* Longley and Hildebrand, 1941, p. 212) says its swimming color phase is faded green, but as often as it descends to the bottom and rests, it assumes a mottled pattern of brown and verdigris, with bands showing under its chin.

This species is scarce in collections and the young of it have not yet been found or, if found, have not been recognized. The 8 specimens in the National collection are from the following localities: Tortugas Island, Florida; Haiti; Colón, Panama; Dominica; and West Indies. Also in the collection are 2 specimens, 73 and 141 mm., USNM 104298, from Brazil, the larger of which I think belongs to this species, but the smaller one may not. In addition, Dr. Bohlke loaned one specimen from the Bahamas.

Sparisoma rubripinnis (Cuvier and Valenciennes)

PLATE 23C,D

Scarus rubripinnis Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 199, 1839 (type locality: Santa Domingo).

Scarus virens Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 203, 1839 (type locality: Puerto Rico, Martinique).

Scarus circumnotatus Poey, Memorias . . . , vol. 2, p. 423, 1861 (type locality: Cuba).

Scarus chloris (not of Bloch and Schneider) Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 204, 1839 (Martinique; 2 specimens examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1768, standard length 70 and 105 mm.).

Scarus truncatus Poey, Repertorio . . . , vol. 2, p. 339, 1868 (type locality: Cuba).

Scarus emarginatus Poey, Repertorio . . . , vol. 2, p. 340, 1868 (type locality: Cuba).

Sparisoma pachycephalum Longley *in* Longley and Hildebrand, Pap. Tortugas Lab. Carnegie Inst. Washington, vol. 34, p. 215, 1941 (type locality: Tortugas, Florida; holotype USNM 117097).

This is the species that Meek and Hildebrand (Marine Fishes of Panama, pt. 3, p. 758, 1928) called *Sparisoma flavescens.* From my study of Bloch and Schneider (Systema Ichthyologiae . . . , p. 290,

1801) and of Parra's (1787) plate 28, fig. 4, on which it was based, I consider it unidentifiable.

Probably most records in the literature to *S. flavescens* refer to this species or to *S. chrysopterum.*

This species is characterized by a rounded dorsal profile at front of head, convex interorbital space; multifid cirri distally on short dermal flap of anterior nostril; pectoral fin plain pale; no dark pectoral spot; under side of chin usually with 2 or 3 bars. There are about 3 color phases: dark brown; mottled; and striped, with several pale or white spots. A brownish opercular spot usually distinct on young. Front of head dorsally may have reticulated brown lines. In the young and immature the caudal fin is usually barred.

The multifid cirri on dermal flap of anterior nostril are well developed at 28 mm. in standard length, but canine teeth do not develop until a length of at least 100 mm. is attained. Numerous long cirri occur on membrane behind tip of each dorsal spine; these are well developed at a length of 35 mm.

Longley (op. cit., pp. 214–215) considered the adult of this species under the name *S. rubripinnis.* He stated that the single mark which best distinguishes it is the yellow caudal fin, but in a color photograph the caudal fin is very light pink barred with some light brown. In life, its color phases are plain, mottled, and striped, respectively. In the first it is tawny olive above, lighter below, caudal fin orange or ochraceous, imperfectly banded; anal fin poppy red, two drab bars on lower jaw. Longley considered the young and immature of this species under the name *S. pachycephalum.* It is obvious from his notes that he was undecided as what to call this species, as his specimens are labeled with various names, of which the most commonly used was *flavescens.*

Only one lot, USNM 117097, was labeled by Longley as *Sparisoma pachycephalum,* and this must be considered as the type material. This lot contained one specimen, 114 mm. in standard length, which I herewith select as the lectotype. In the same jar were numerous small specimens, all shorter than 56 mm. in standard length, that had not been sorted carefully by either Longley or by Hildebrand, as this material contained one *Cryptotomus,* numerous specimens of *S. chrysopterum* and several small ones of this species. Much of the material reported upon from Panama by Meek and Hildebrand as *S. flavescens* contained specimens of *S. chrysopterum.*

Details of the color pattern of the immature of this species are as follows: Color generally brownish; no trace of a dark opercular spot but sometimes the young, as in certain other species of *Sparisoma,* have whitish spots; at lengths up to 160 mm. in standard length the caudal fin is barred, the basal white bar is widest, but not as wide and

as distinct as in *S. abilgaardi;* the barred pattern of the caudal fin contains rather characteristic large rounded white areas; distal margin of caudal is white over an area usually half the width of the pupil of eye; a dark scale just behind upper edge of opercular opening, partly covered by the opercular flap is a characteristic mark.

Dr. Howard Winn, University of Maryland, records the living colors for a mature male, about 365 mm. in standard length, collected at Bermuda, July 21, 1956, as follows: Caudal fin yellow, anal red, pelvics dark pink, pectoral pink, dorsal yellowish-brown; ventral part of body reddish. In alcohol the pectoral base is brown, and pectoral fin whitish.

I have examined a large number of lots of this species, some of which contain numerous specimens, from the following localities: Florida, 11 lots; Florida Keys, 10; Cuba, 3; Puerto Rico, 8; Old Providence Island, 2; Panama, 17; Cozumel, 2; Sabinilla, 1; West Indies, 2; St. Lucia, 1; Curacao, 1; Gulf of Venezuela, 1; and Brazil, 2. Also 3 lots from Bermuda, loaned by the Chicago Natural History Museum and 23 lots from the Bahamas, loaned by Dr. Böhlke.

I have not seen a specimen of this species from the East Atlantic.

Sparisoma chrysopterum (Bloch and Schneider)

PLATES 4,B; 23,B

Scarus chrysopterum Bloch and Schneider, Systema ichthyologiae . . . , p. 286, pl. 57, 1801 (type locality: "American Seas").

Scarus squalidus Poey, Memorias . . . , vol. 2, p. 218, 1860 (type locality: Cuba).

Scarus lateralis Poey, Memorias . . . , vol. 2, p. 219, 1860 (type locality: Cuba; holotype USNM 154844).

Scarus brachialis Poey, Memorias . . . , vol. 2, p. 345, 1861 (type locality: Cuba).

Scarus maschalespilos (in part) Bleeker, Versl. Akad. Amsterdam, vol. 14, p. 127, 1862 (type locality: Surinam).

Sparisoma lorito Jordan and Swain Proc. U. S. Nat. Mus., vol. 7, p. 95, 1884 (type locality: Havana; holotype USNM 35082).

Sparisoma elongatum Meek and Hildebrand, Marine fishes of Panama, pt. 3, p. 575, pl. 74, fig. 2, 1928 (type locality: Panama City Market, Panama; holotype USNM 81504).

This species is characterized by the slightly concave interorbital space, sometimes flattish, only a trifle convex in young; upper edge of base of pectoral with a saddlelike dark spot, absent in small juveniles; anterior nostril with a ribbonlike dermal flap that may have at its distal tip from none to about 4 cirri, rarely one more in adults and sometimes a few little knoblike cirri along edge of dermal flap; membranes just behind tips of dorsal spines usually without a dermal cirrus, sometimes with 1 or 2 feeble ones, the tip of dorsal spine usually ends in a short cirrus; caudal fin truncate to concave or even

forked in adults; short stubby canine teeth develop on sides of dental plates of upper jaw, and in our largest specimen, 285 mm. in standard length, are 6 to 8 of them; this species like some others, may have some small interlocking canine teeth at suture of dental plate of upper jaw.

The color pattern is variable. One of the commonest is the grayish mottled pattern with scattered pale or white spots, and with the nasal tentacle milk colored. In the brownish color phase the caudal fin and the underside of lower jaw are barred, a common characteristic of other species of *Sparisoma.*

A small dark blotch on dorsal edge of caudal peduncle at midlength and another at base of rays of upper caudal fin are characteristic at standard lengths up to 100 mm., or even longer; caudal fin is crossed by about 3 dark bars, the widest white bar occurs in basal part of caudal fin; at a length of 180 mm. the central region of caudal fin is white; scale opposite upper edge of opercular opening is blackish; the immature, up to 80 mm., may have a wide dusky band from behind eye along midside but at the point about opposite midlength of pectoral fin this band is not intensified as in *aurofrenatum;* area in front of eye and on side of snout usually has a reticulated pattern of dark circles in specimens of about 80 to 160 mm. or longer.

Since the genus *Sparisoma* is not represented in the Pacific Ocean except by the market specimen described by Meek and Hildebrand as *S. elongatum,* and since that specimen is exactly the same as *S. chrysopterum,* the most abundant species of the genus in the Atlantic, all evidence indicates this specimen may have been caught in the Atlantic and transported to the Panama City market where it was obtained.

I have examined many lots of this species, some of which contain a large number of specimens, from the following localities: Bermuda, 4; Tortugas Island, 10; Florida, 27; Florida Keys, 18; Antigua, 1; Cuba, 10; Haiti, 4; Bahamas, 2; Puerto Rico, 11; St. Croix, 1; Old Providence Island, 2; Sabinilla, 1; Barbados, 2; Cozumel, 4; Panama, 6; Curacao, 2; New Providence Island, 1; Nassau, 2; St. Lucia, 1; Jamaica, 2; West Indies, 4. Also, 25 lots from Bermuda were loaned by the Chicago Natural History Museum and 22 lots from the Bahamas were loaned by Dr. Böhlke.

I have not seen a specimen of this species from the East Atlantic.

Sparisoma abildgaardi (Bloch)

PLATES 4,C; 24, A,B

Sparus abildgaardi Bloch, Naturgeschite der ausländischen Fische, vol. 5, p. 22, pl. 259, 1791 (type locality: America).

Scarus coccineus Bloch and Schneider, Systema ichthyologiae . . . , p. 289, 1801 (type locality: Cuba; based on Parra 1787).

Sparus aureoruber Lacépède, Histoire naturelle des poissons, vol. 4, pp. 55, 163, 1803 (type locality: Martinique; based on Plumier 1695).

Scarus frondosus Cuvier *in* Spix and Agassiz, Selecta genera et species piscium quos in itinere per Brasilian annis 1817–20 . . . , peracto collegit . . . , p. 98, pl. 54, 1829 (type locality: Brazil; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1764).

Scarus amplus Ranzani, Novi Comment. Acad. Sci. Inst. Bonon., vol. 5, p. 324, pl. 25, 1842 (type locality: Brazil).

This species is characterized by its coloration, which consists of dark brown edges to scales in dorsal ⅔ of body, these scales with pale or white centers; the 16 scales with white centers are usually arranged in 6 vertical rows; posterior margin of gill cover black edged (reddish brown when alive), but not on small juvenile specimens; head with reticulated brown lines dorsally, mottled brown and white on sides and ventrally; lower part of body below level of pectoral fin base whitish (blood red when alive); caudal fin red except basally; dermal flap of anterior nostril with multifid cirri in adults, that may reach posterior nasal opening, this dermal flap ribbonlike in young; interorbital space a little convex or almost flat; an especially distinct pale or white bar on underside of head below corners of mouth on specimens shorter than 130 mm; pectoral fin base pale; caudal fin distally changing from truncate to forked on large adults; greatest depth of body 2.4 to 2.5 times in standard length.

In the young the white spots on side are fewer than 16; nasal tentacle has only 1 to 5 cirri at standard lengths of 80 to 100 mm.; and no cirri occur on membraneous edge of spiny dorsal fin.

Longley (*in* Longley and Hildebrand, 1941, pp. 207–208) describes this "red parrotfish" as having, when alive, a highly variable coloration: brown, changing to red ventrally, head washed with yellow; 16 white spots, one to each scale, on sides; creamy band crossing the caudal fin; in an unspotted phase, both dark and light, margins of scales are darker; a blotched phase also occurs.

The most characteristic color mark on the young is the dark brown coloration with a broad white bar across basal third of caudal fin, whereas the distal two-thirds is barred; on specimens 20 to 30 mm. in standard length the distal two-thirds of caudal fin is only partially barred, and on those shorter than 20 mm. the caudal fin is white. Specimens longer than 30 to 40 mm. have the distal edge of caudal fin very narrowly edged with white. The blackish edge of the opercular membrane begins to appear at about 60 mm. and is strongly developed at 80 mm. A dark brown or blackish round spot occurs opposite upper edge of opercular opening, most prominent on those up to 50 mm.

This species might be confused with *S. radians*, because a prominent canine tooth develops on the midside of the upper dental plate at lengths of 30 to 35 mm. This canine tooth is located a little more

posteriorly than in *S. radians*, and as *S. abilgaardi* gets larger this canine tooth becomes proportionately more so. The distance to canine tooth from suture between upper dental plates is contained from 1.9 to 2.3 times in distance between centers of posterior nostrils, whereas in *S. radians* it is contained 2.5 to 3.0 times. The latter does not have a wide white bar on caudal fin base.

Our specimens are in lots from the following localities: Puerto Rico, 1 lot; Jamaica, 1; Barbados, 3; Haiti, 3; St. Thomas, 4; Cuba, 2; Curacao, 1; Florida, 1; and West Indies, 3. I have also seen 1 specimen from Bermuda, loaned by the Chicago Natural History Museum, and 27 lots from the Bahamas, loaned by Dr. Böhlke.

Genus Calotomus Gilbert

Calotomus Gilbert, Proc. U. S. Nat. Mus., vol. 13, p. 70, 1890 (genotype: *C. xenodon* Gilbert).

This group of fishes was listed by Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 8, p. 260, 1940) under the generic name, *Cryptotomus* Cope. The genotype of *Cryptotomus, C. roseus*, represents a distinct phyletic line. Weber and de Beaufort give "*Calliodon*" Cuvier (Règne Animal, ed. 2, vol. 2, p. 266, 1829) as a valid generic name, which it is not; Cuvier uses "Les Callidons," as a common name only.

This genus is characterized by having flexible dorsal spines, gill membranes joined to isthmus without a free fold; anterior nasal opening with a broad dermal cirrus; teeth coalesced into a plate in both jaws and the internal edge usually serrated; externally on the plates occur 2 to 8 rows (more on large adults) of obliquely arranged imbricated pointed incisorlike teeth, 1 to 4 canines on midsides of upper jaw, these hooked somewhat out and backward; beginning at standard lengths of about 60 mm. short conical teeth may occur on the inside surfaces of the coalesced dental plate of upper jaw, these teeth variously arranged and may be absent in large adults; no canines on lower jaw; caudal fin truncate to concave in adults, the outer rays may be elongate; gill rakers 2 to 4+1+7 to 13.

KEY TO THE SPECIES OF THE GENUS CALOTOMUS

1*a*. Caudal fin truncate in young to concave in those longer than 100 mm. in standard length and deeply concave in larger specimens; distal margin of caudal fin broadly white edged; length of middle caudal fin rays from ¾ to equal to longest pectoral fin ray; plate 24,c. (Hawaiian Islands, Central and West Pacific, Indian Ocean.)
spinidens (Quoy and Gaimard)

1*b*. Caudal fin rounded at all sizes; distal edge dusky, not white; length of middle caudal fin rays equal in young to or longer than longest pectoral fin ray; plate 24,D. (West Pacific, Indian Ocean.)
japonicus (Cuvier and Valenciennes)

396816—58——9

Calotomus spinidens (Quoy and Gaimard)

PLATES 5,B; 24,C

Scarus spinidens Quoy and Gaimard, Voyage autour du monde . . . exécuté sur . . . l'*Uranie* et la *Physicienne*, Zoologie, p. 289, 1824 (type locality: Vaigiou).

Scarus (Calliodon) *viridescens* Rüppell, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig, p. 23, pl. 7, fig. 2, 1835 (type locality: Red Sea).

Callyodon waigiensis Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 296, 1839 (type locality: Vaigiou; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 571, 90 mm. standard length).

Callyodon sandwicensis Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14 p. 295, 1839 (type locality: Hawaiian Islands).

Callyodon carolinus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 291, 1839 (type locality: Caroline Islands).—Bleeker, Atlas ichthyologique . . . , vol. 1, p. 14, pl. 2, fig. 4, 1862.

Callyodon genistriatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 293, 1839 (type locality not given).—Bleeker, Atlas ichthyologique . . . , vol. 1. p. 13, pl. 1, fig. 1, 1862.

Callyodon brachysoma Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 244, 1861 (type locality: Amboina, Ternata; type examined in British Museum, Cat. No. 1861.2.28.16, standard length 110 mm.); Atlas ichthyologique . . . , vol. 1, p. 14, pl. 2, fig. 3, 1862.

Calotomus irradians Jenkins, Bull. U. S. Fish Comm. vol. 19 (1899), p. 58, fig.15 1900 (type locality: Hawaii).

Calotomus snyderi Jenkins, Bull. U. S. Fish Comm. vol. 22 (1902), p. 467, fig. 25, 1903 (type locality: Honolulu; holotype USNM 50850).

Calotomus xenodon Gilbert, Proc. U. S. Nat. Mus., vol. 13, p. 70, 1890 (type locality: Socorro Island, Revillagigedo group; holotype USNM 46935.—Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 4, pl. 243, figs. 609–609,a, 1900.

Callyodon hypselosoma Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 8, p. 425, 1855 (type locality: Amboina).

Scarichthys rarotongae Seale, Occ. Pap. Bishop Mus., vol. 4, No. 1, p. 59, fig. 8, 1906 (type locality: Rarotonga, Cook Islands; Dr. Gosline has kindly furnished needed information on the holotype, BPBM No. 1903, 69 mm. standard length).

This species is characterized by having the background mottled gray and brown; fins grayish; radiating from eye are bands, two of which are more prominent, that extend from below eye to rear of mouth; snout more or less crossbarred; the color around the head somewhat variable; a dark blotch on membrane between dorsal spines I and II at standard lengths of 148 to 158 mm; caudal fin with posterior margin broadly white edged (this white margin has a submarginal brownish line at standard length of 190 mm.), outer half of anal fin dusky, basal half pale, somewhat pale spotted; some scales on sides may have pale or white centers, but most of the scales are outlined with brown, rest of scale pale, or scales may have pale mottlings; base of last 3 soft dorsal rays may have a black spot; anus blackish under scaly sheath; base of pectoral dark brown in specimens

shorter than 130 mm., extremely dark brown or blackish in those shorter than 75 mm.

In live specimens the background is reddish brown, with brighter red mottlings in fins and red streaks radiating from eye, 2 or 3 extending to mouth; lower jaw with red blotches.

I cannot agree with Weber and de Beaufort in regard to referring this species to the genus *Cryptotomus*, which is represented by only *C. roseus* in the Atlantic. However, after studying the large series of *Calotomus spinidens* in the national collection I agree with them in recognizing a wide-ranging species.

The following gill raker counts were recorded from the first arch:

Species	Above angle			At angle	Below angle						
	2	3	4	1	7	8	9	10	11	12	13
spinidens	2	18	4	24	1	7	7	2	3	3	1
japonicus		5		5		5					

In addition to the types examined, I have seen specimens from the following localities: Marshalls, 18 lots; Marianas, 2; Johnson Island, 1; Hawaiian Islands, 8; Philippines, 10; Kapingamarangi, 1; Dutch East Indies, 3; Ifaluk Atoll, 6; Mauritius, 1; and Moorea Island, Society Islands, 1.

Calotomus japonicus (Cuvier and Valenciennes)

PLATES 5,A; 24,D

Callyodon japonicus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 294, pl. 406, 1839 (type locality: Japan).

Callyodon moluccensis Bleeker, Versl. Akad. Amsterdam, vol. 12, p. 243, 1851 (type locality: Celebes, Ternata, Batjan, Timor, Amboina, Ceram, Banda; cotype examined in British Museum, Cat. No. 1864.5.15.33, standard length 101 mm.); Atlas ichthyologique . . . , vol. 1, p. 12, pl. 2, fig. 1, 1862.

Callyodon spinidens (not of Quoy and Gaimard) Bleeker, Atlas ichthyologique . . . , vol. 1, pl. 2, fig. 2, 1862.

Calotomus cyclurus Jenkins, Bull. U. S. Fish Comm., vol. 22 (1902), p. 465, fig. 24, 1903 (type locality: Honolulu; holotype USNM 50849).

The immature (longer than 70 mm. standard length) of this species may be recognized by the presence on each side of the upper jaw of 4 caninelike teeth that flare outward, the rear two of which are located somewhat posteriorly; this tooth character aids in distinguishing *Calotomus japonicus* from *Scaridea zonarcha*.

There is considerable variability in ratio of depth to length and in color pattern. Pale bands may or may not radiate from eye.

I have examined specimens in lots from the following localities: Okinawa, 1 lot; Japan, 9; Paumotus, 1; Palau Islands, 2; Dutch East Indies, 1; Philippine Islands, 27; and Mauritius, 1.

Genus Leptoscarus Swainson

Leptoscarus Swainson, Natural history . . . fishes, vol. 2, pp. 172, 226, 1839 (genotype: *Scarus vaigiensis* Quoy and Gaimard)

Scarichthys Bleeker, Acta Soc. Sci. Indo-Néerl. vol. 6, p. 17, 106, 107, 1859; Nat. Tijdschr. Nederl.-Indië, vol. 19, p. 334, 1859 (genotype: *Scarus naevius* Bleeker, designated by Jordan, Genera of fishes pt. 3, p. 287, 1919. *Scarichthys naevius* Bleeker = *Scarus naevius* Cuvier and Valenciennes = *Scarichthys coeruleopunctatus* Bleeker = *Scarus* (*Calliodon*) *coeruleopunctatus* Rüppell = *Scarus vaigiensis* Quoy and Gaimard).

Leptoxanus Baissac, Proc. Soc. Arts Sci. Mauritius, vol. 1, pt. 4, p. 334, 1956 (genotype: *Leptoxanus waigensis* (Quoy and Gaimard) = *Scarus vaigensis* Quoy and Gaimard); ibid., p. 396 (correction of misspelling of *Leptoscarus*).

Leptoscarus vaigiensis (Quoy and Gaimard)

PLATES 4,A; 25,A, B

Scarus vaigiensis Quoy and Gaimard, Voyage autour du monde . . . exécuté sur . . . l'*Uranie* et la *Physicienne*, Zoologie, p. 288, 1824 (type locality: Vaigiou).

Scarus (*Calliodon*) *caeruleo-punctatus* Rüppell, Neue Wirbelthiere zu der Fauna von Abysinnien gehörig, p. 24, pl. 7, fig. 3, 1835 (type locality; Red Sea):—Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 262, 1839 (Red Sea; 3 specimens examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 1756, and 2 in Cat. No. 583).

Scarus auritius Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 218, 1839 (type locality: Java; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 567).

Scarus naevius Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 253, 1839 (type locality: Sechelles; type examined in Mus. Nat. Hist. Nat. Paris, Cat. No. 556).

Calliodon chlorolepsis Richardson, Zoology of the voyage of H. M. S. *Sulphur* . . . , Ichthyology, p. 137, pl. 64, figs. 4–7, 1844 (type locality: Hong Kong; type examined in British Museum, Cat. No. 1847.5.10.14, standard length 124 mm.)

Scarichthys coeruleopunctatus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 16, pl. 1, fig. 2, 1862.

Scarichthys auritus Bleeker, Atlas ichthyologique . . . , vol. 1, p. 15, pl. 1, fig. 3, 1862.

Scarus rubronotatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 212, 1839 (type locality: Gulf of Arabia and Red Sea).

Scarus bottae Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 262, 1839 (type locality: Red Sea).

This species is characterized by having a background coloration of brownish above, light brown ventrally; head, body, and fins sometimes richly speckled with dark brown dots (blue in life); base of pectoral blackish or dark brown; scales of lower 3 lengthwise scale rows have brownish centers, giving the appearance of 3 alternating light and dark streaks behind pectoral fin.

It seemed strange to me that the two species currently known as *Leptoscarus vaigiensis* and *Scarichthys coeruleopunctatus* should be

identical in coloration and all other characters except one has canine teeth and the latter lacks them. I therefore attempted to determine the sex of all our specimens that had not been eviserated. Without exception, all 25 adult specimens without canine teeth were females and all 16 adult specimens with canine teeth were mature males. A mature male, 101 mm. standard length, has well developed canines. It was concluded that the presence or absence of canine teeth in this species represented another case of sexual dimorphism.

This species occurs in the Central and West Pacific and the Indian Ocean. I have seen numerous specimens in lots from the following localities: Okinawa, 1 lot; Guam, 1; Paumotus, 1; Philippine Islands, 138; Red Sea, 3; and Mauritius, 1.

Genus Cryptotomus Cope

Cryptotomus Cope, Trans. Amer. Philos. Soc., vol. 14, p. 462, 1871 (genotype: *Cryptotomus roseus* Cope).

This genus occurs in the West Atlantic and at Bermuda.

Cryptotomus roseus Cope

PLATES 5c; 25,c

Cryptotomus roseus Cope, Trans. Amer. Philos. Soc., vol. 14, p. 462, figs. 1, 1,a, 1871 (type locality; St. Martin, West Indies).

Cryptotomus crassiceps T. H. Bean, Proc. Biol. Soc. Washington, vol. 19, p. 32, 1906 (type locality; Cooper's Island, Bermuda; holotype (lectotype) CNHM 4964 and paratype USNM 163555 both examined).

This genus and species is characterized by its elongate form; long pointed snout, profile of head pointed, the angle between dorsal and ventral profile about 40 to 50 degrees; inner lip not free at front of snout; no dermal cirrus on anterior nostril, only a raised low rim; external incisorlike teeth at front of mouth, especially those of lower jaw, slanting obliquely forward; when mouth is closed, tips of teeth of lower jaw not directed at those of upper jaw but slanting forward; canine teeth present on side of upper jaw of half grown and adults.

In alcohol, the pectoral fin base at its dorsal edge has a dark brown or black spot. Dr. Longley (*in* Longley and Hildebrand, 1941, pp. 205–206) describes the color of live specimens as bluish gray above, head green, bluish white below; red stripe from upper margin of opercular cleft almost to caudal base, set off by light lines above and below; two narrow red or blue lines from eye to rictus of mouth; iris red; a half dozen red spots below and behind eye; orange red dashes on pectoral base, blue spot at base of upper rays. The dark spot at base of upper pectoral rays is lacking in young shorter than 70 mm. in standard length; a 20-mm. specimen has an oblique dark bar across upper and lower lobes of caudal fin.

I have studied 20 specimens from the following localities: Tortugas Island, Florida; Cuba; Curacao; Panama; Bahia, Brazil; and Bermuda. In addition, 22 specimens from New Providence Island, Bahamas, were loaned by Dr. Böhlke.

Genus Nicholsina Fowler

Nicholsina Fowler, Copeia, No. 14, p. 3, 1915 (genotype: *Cryptotomus beryllinus* Jordan and Swain).

Xenoscarus Evermann and Radcliffe, U. S. Nat. Mus. Bull. 95, p. 129, 1917 (genotype; *Xenoscarus denticulatus* Evermann and Radcliffe.)

KEY TO THE SPECIES OF THE GENUS NICHOLSINA

1*a*. Pectoral fin base same color as body, without dark spot; distal edge of caudal fin not white edged; plate 25,D. (Western tropical Atlantic.)
ustus (Cuvier and Valenciennes)

1*b*. Pectoral fin base dark, distal edge of caudal broadly white edged in young; plate 26,B,C. (Eastern tropical Pacific.)
denticulatus (Evermann and Radcliffe)

This genus is characterized by having the gill membranes with a narrow free fold across the isthmus, flexible dorsal spines, 4 median predorsal scales, 1 row of scales on cheek; ii,11 pectoral rays; external incisorlike teeth at front of both jaws; these teeth curve so as almost to oppose each other; dermal flap on anterior nostril simple, usually not reaching posterior nasal opening; canine teeth may occur at sides of upper jaw on immature as well as on adults, but more often on latter.

The statements by authors that *C. ustus* may be distinguished from *C. auropunctatus* does not appear to be true, thus they have been considered as a single species.

Nicholsina ustus (Cuvier and Valenciennes)

PLATE 25,D

Callyodon ustus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 286, pl. 405, 1839 (type locality: Brazil; types examined in Mus. Nat. Hist. Nat. Paris, Cat. Nos. 2195, A 9290, a dried specimen, and 2194, in bad condition).

Callyodon auropunctatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 290, 1839 (type locality: St. Domingo; type examined in Mus. Nat. Hist. Nat. Paris, Cat. Nos. 2192 and 2193, both in very bad condition, no color).

? *Scarus dentiens* Poey, Memorias . . ., vol. 2. p. 422, 1861 (type locality: Cuba).

Cryptotomus beryllinus Jordan and Swain, Proc. U. S. Nat. Mus., vol. 7, p. 101, 1884 (type locality: Key West, Florida; Havana; holotype USNM 35097 and paratype 35162).—Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 4, pl. 242, fig. 608, 1900.

? *Calliodon retractus* Poey, Synopsis piscium cubensium, p. 345, 1868 (type locality: Cuba).

The striped color phase of the young consists of a pale streak above lateral line in the brownish dorsal half of body, whereas lower half of body is abruptly paler below a nearly white midlateral streak; other variations consist of plain pale or mottled brown coloration. In adults, the snout is more than half length of head and becomes more rounded and the interorbital space is convex.

I am unable to verify the differences that Longley and Hildebrand (1941, pp. 206–207) recognize as separating *Callyodon auropunctatus* from *C. ustus*, nor can I find new ones that will serve to distinguish these two forms.

I have examined a large number of lots of this species, some containing numerous specimens, from the following localities: Sommers Point, New Jersey, 1; North Carolina, 2; Long Bay, South Carolina, 1; Florida, 7; Florida Keys, 15; Tortugas Island, Florida, 7; Cuba 2; Bermuda, 1; Yucatán, 1; Gulf of Campeche, 1; Gulf of Venezuela, 1; Panama, 3; Rio de Janeiro, Brazil, 1.

Nicholsina denticulatus (Evermann and Radcliffe)

PLATES 5,D; 26B,C

Xenoscarus denticulatus Evermann and Radcliffe, U. S. Nat. Mus. Bull. 95, p. 129, pl. 12, fig. 1, 1917 (type locality: Lobos de Afuera, Peru; holotype USNM 77619).

Xenoscarus hubbsi Harry, Amer. Midl. Nat., vol. 43, p. 147, figs. 2, 3, 1950 (type locality; Guaymas, Sonora, Gulf of California, Mexico).

I have compared 28 specimens from the Gulf of California, kindly loaned by Dr. Boyd Walker, University of California at Los Angeles, with 40 specimens from Peru, including the holotype of *Xenoscarus denticulatus*. Harry described juvenile specimens of *Nicholsina denticulatus* as *Xenoscarus hubbsi*, but when specimens of the same sizes are compared, all his measurement differences disappear; the number of midlateral series of scales is 21 in all localities with little variability; the anteriormost predorsal scale extends into the interorbital space in specimens from both localities; the number of oblique rows of incisorlike teeth increases from 2 to 7 with increase in size; the last midlateral line scale is very variable in size, larger or smaller than the penultimate scale; the color pattern varies with age; and I am unable to find any character or group of characters that distinguishes *X. hubbsi* as even a subspecies.

Genus Euscarus Jordan and Evermann

Euscarus Jordan and Evermann, Check-list of the fishes and fish-like vertebrates of North and Middle America, Rep. U. S. Fish. Comm., 1895, app. 5, p. 416, Dec. 28, 1896 (genotype; *Labrus cretensis* Linnaeus).

This genus is distinguished from all other genera in the subfamily Sparisomatinae by having 5 median predorsal scales instead of 4, otherwise it has the same characters as the genus *Sparisoma*. It occurs only in the East Atlantic and the Mediterranean.

KEY TO THE SPECIES OF THE GENUS EUSCARUS

1*a*. A distinct blackish or dark brown blotch just behind head above pectoral and below lateral line; tip of opercular flap blackish; caudal fin with the distal border pale; the smaller specimens may lack the black shoulder spot, but are generally red when alive; plate 26,D. (East Atlantic and Mediterranean.) . . . . . **cretensis** (Linnaeus)

1*b*. No dark shoulder spot; a series of blackish or dark brown scales along lateral line sometimes interrupted fore or aft; a white triangular spot behind mouth; underside of head and snout dark brown; plate 26,A. (St. Helena, East Atlantic.) . . . . . **strigatus** (Günther)

Euscarus cretensis (Linnaeus)

PLATES 4,C; 26,D

Labrus cretensis Linnaeus, System naturae, ed. 10, vol. 1, p. 474, 1758 (type locality; Madeira, Canary Islands).

Scarus cretensis Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 164, pl. 400, 1839 (Canary Islands).

Scarus rubiginosus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 14, p. 171, 1839 (type locality: Canary Islands; 3 types in bad condition examined in Paris Mus. Nat. Hist. Nat. Cat. No. 1774).

Scarus canariensis Valenciennes, Ichthyologie des îles Canaries . . . , vol. 2, p. 68, pl. 17, fig. 2, 1836 (type locality: Canary Islands).

Scarus mutabilis Lowe, (not of Gray 1854) Trans. Zool. Soc. London, vol. 2, p. 187, 1841 (type locality; Madeira).

I have studied specimens in lots from the following localities: Canary Islands, 1; Madeira, 3; Azores, 1.

Euscarus strigatus (Günther)

PLATE 26,A

Scarus strigatus Günther, Catalogue of the fishes in the British Museum . . . , vol. 4, p. 212, 1862 (no locality given but type locality is St. Helena; holotype examined in British Museum, No. 4: 212).

The following notes were made on the holotype and 4 additional specimens, in the British Museum, of this species, which is known only from St. Helena. Upper pharyngeals in 2 main rows, with an outer rudimentary row, the inner main row does not interdigitate with that of opposite side; 7 teeth in middle rows of lower pharyngeals. Black isolated scales occur on opercle, below eye on cheek along lateral line with additional ones scattered on body; caudal fin truncate to rounded.

I have studied 5 specimens from St. Helena.

Addenda

While the page proof of this bulletin was being indexed, a small collection of parrotfishes was received from Dr. H. Steinitz, The Hebrew University, Jerusalem. For his cooperation I am grateful.

Whenever new material becomes available for study, new information is discovered that is likely to alter conclusions. Among the Steinitz collection were two species of parrotfishes, not previously seen by me. One, represented by two specimens, I identify as *Scarus madagascarensis* on the basis of color pattern and other characters. An examination of the pharyngeal mill of one of the specimens definitely indicated that it did not belong in the genus *Scarops*, even though the color pattern was somewhat similar to that of *Scarops rubroviolaceous*.

The other species, *Scarus bipallidus*, is described and figured below.

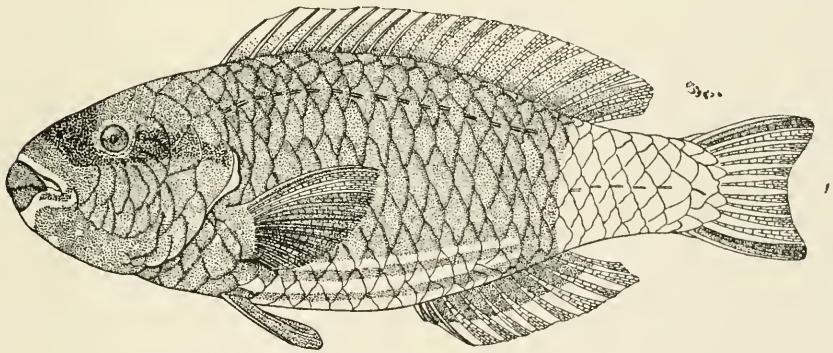


FIGURE 31.—*Scarus bipallidus* (Smith), from three specimens collected by Dr. Steinitz in the Red Sea. (Drawing by Mrs. Patricia Isham.)

Scarus bipallidus (Smith)

FIGURE 31

Callyodon bipallidus J. L. B. Smith, Ann. Mag. Nat. Hist., ser. 12, vol. 8, p. 936, December 1955 (type locality: western Indian Ocean).

Xanothon bipallidus J. L. B. Smith, Rhodes Univ. Ichthy. Bull. No. 1, p. 5, pl. 41,D, 1956 (type locality: Pinda, South Africa).

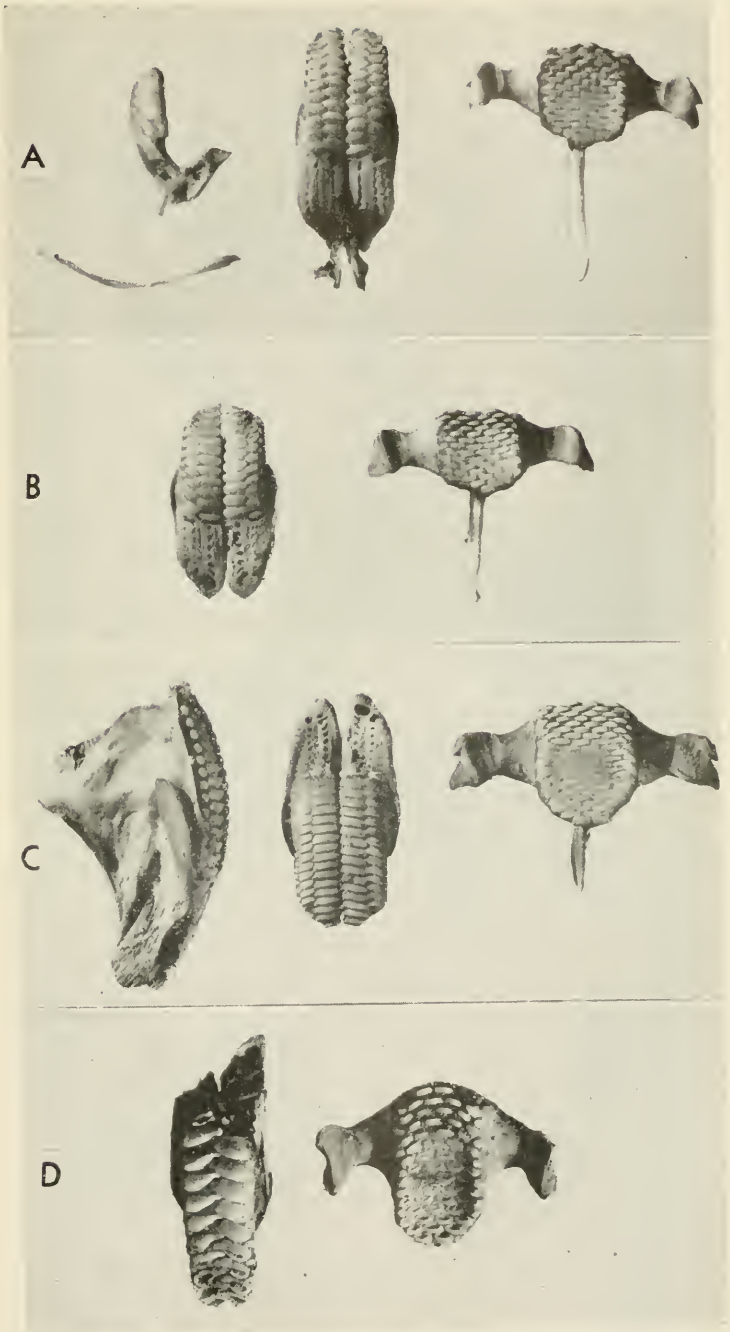
This species is characterized by having 4 median predorsal scales, 2 rows of scales on the cheek, pectoral rays ii,13, green teeth in adult (immature not seen); in alcohol a pale caudal peduncle and caudal

fin contrasting sharply with otherwise brownish body; outer ½ to ⅔ of dorsal and anal fins pale, basal ½ to ⅔ darker, separated by a dark line; angle between lips about 80 to 95 degrees.

Three specimens from the Red Sea clarifies the status of *S. bipallidus* (Smith), which I first thought was the same as *S. sordidus* Forskål. In my key on pp. 33–38, *S. bipallidus* would trace down (with difficulty) to *S. sordidus* in sections 20a and 20b, or perhaps to 20c. From all the species falling under those sections of the key, *S. bipallidus* differs in having a dark squarish blotch (purplish when alive) on front of snout, and a pale (light green when alive) caudal peduncle and caudal fin; the basal third of anal fin is red, outer ⅔ light green. The chief color marks are illustrated in the figure. The width of the dark broad band on the anal fin of *S. sordidus*, narrower in *S. bipallidus* along with the purplish blotch on the snout, is especially characteristic.

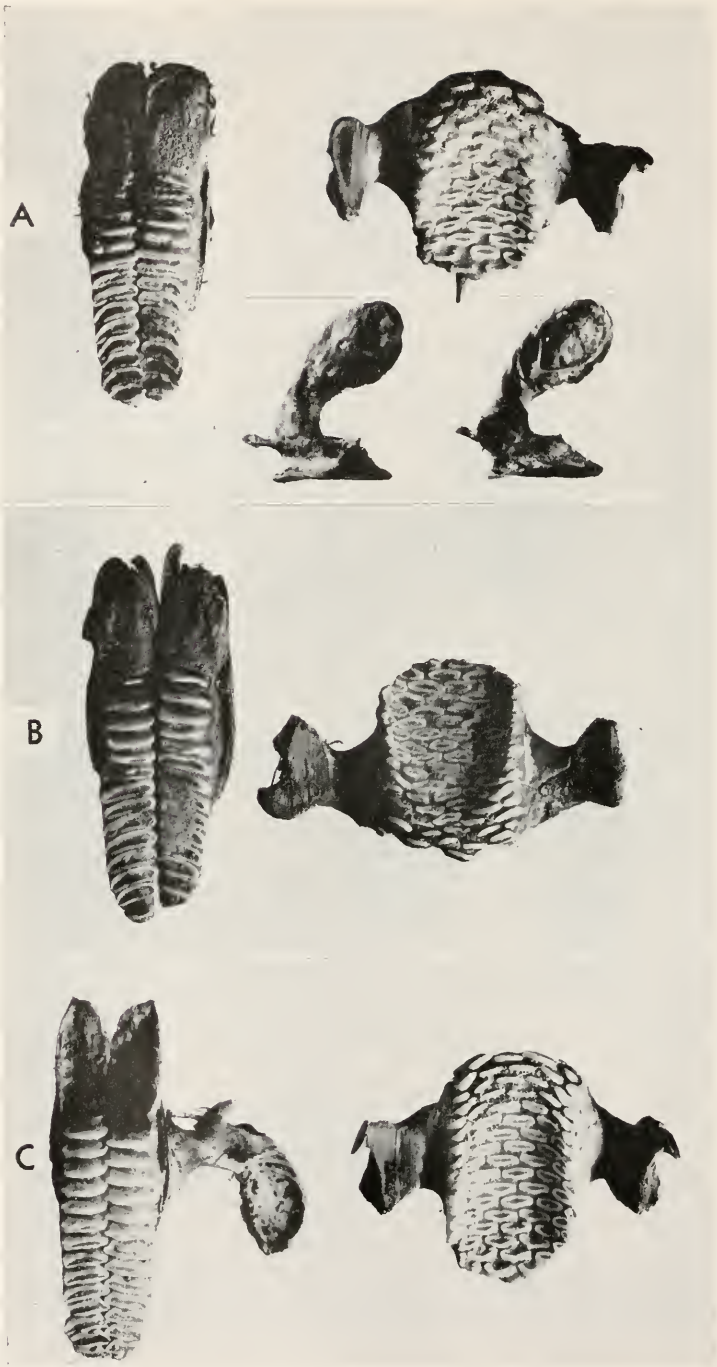
No doubt a study of new material from various parts of the world will make it possible to validate other doubtful species, now placed in synonymy by me.

Plates

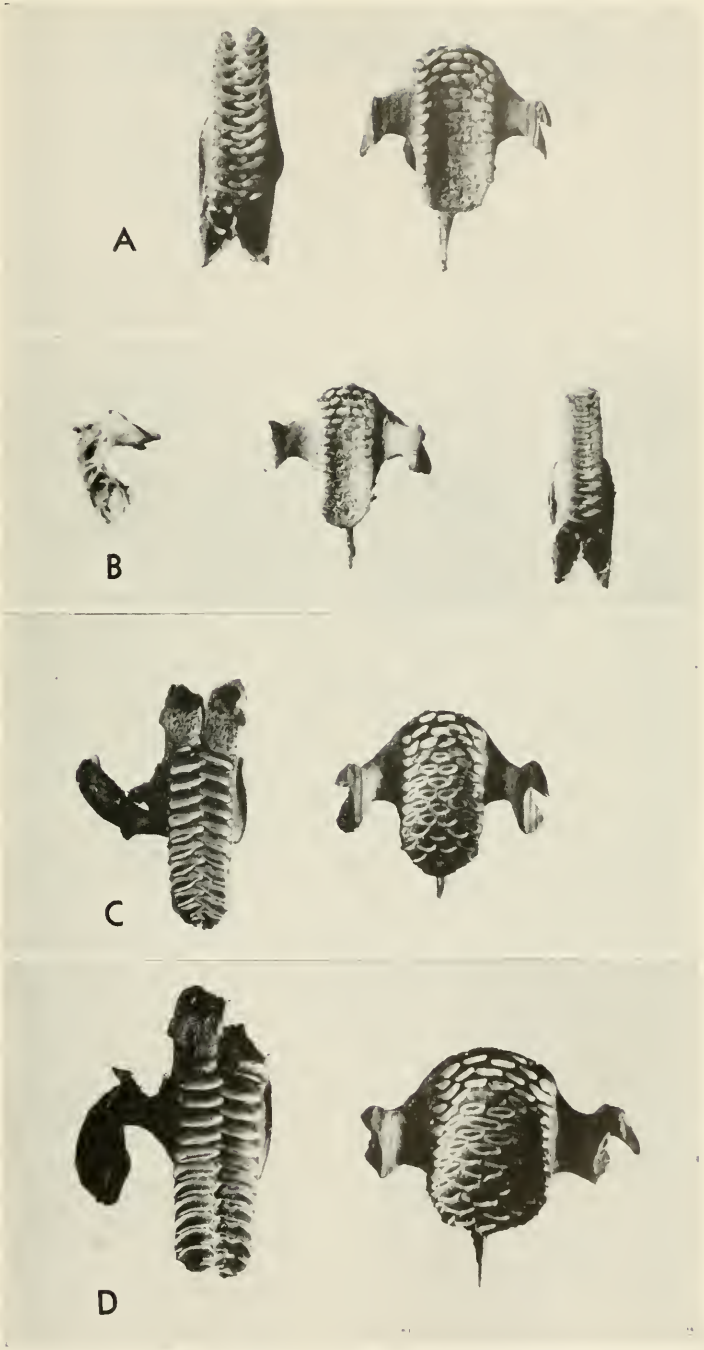


Pharyngeal mill: A, *Chlorurus gibbus*, USNM 84242; B, *C. bicolor*, USNM 147231; C, *C pulchellus*, USNM 157248; D, *Scarus* (*Ypsiscarus*) *oedema*, USNM 147305.

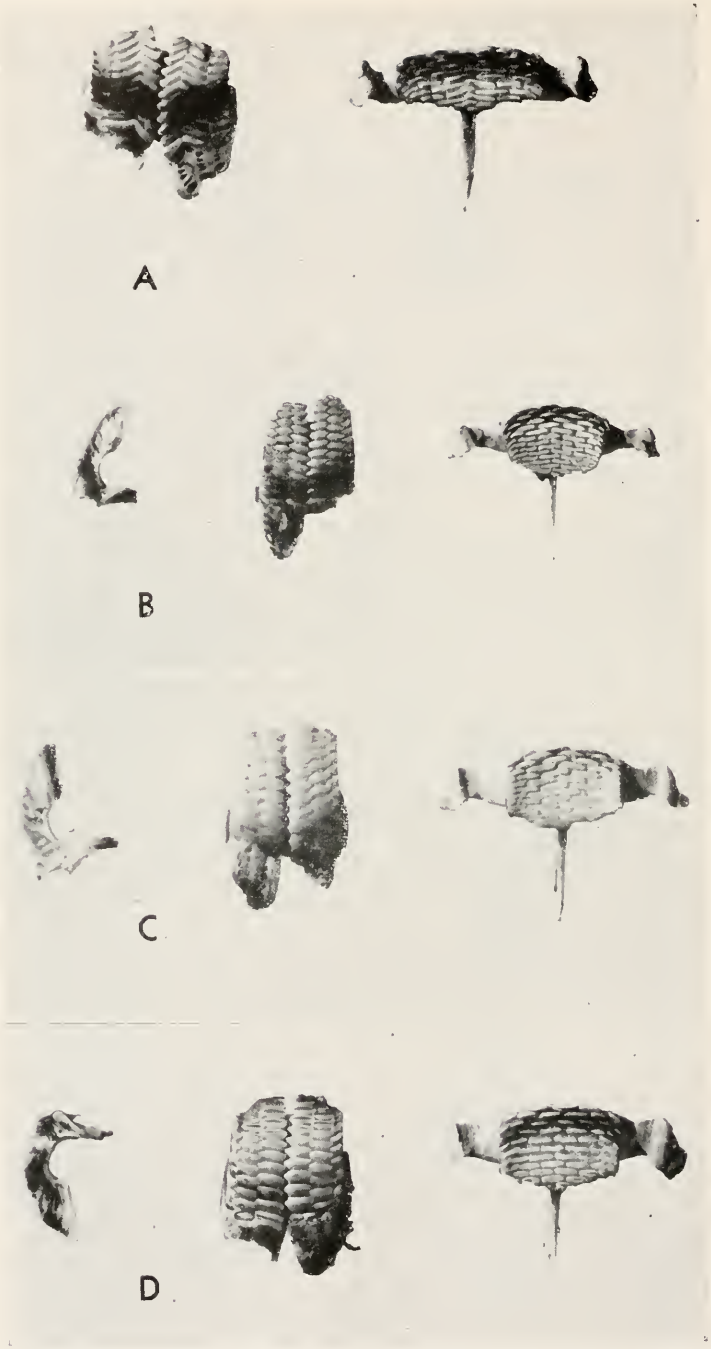
396816—58——10



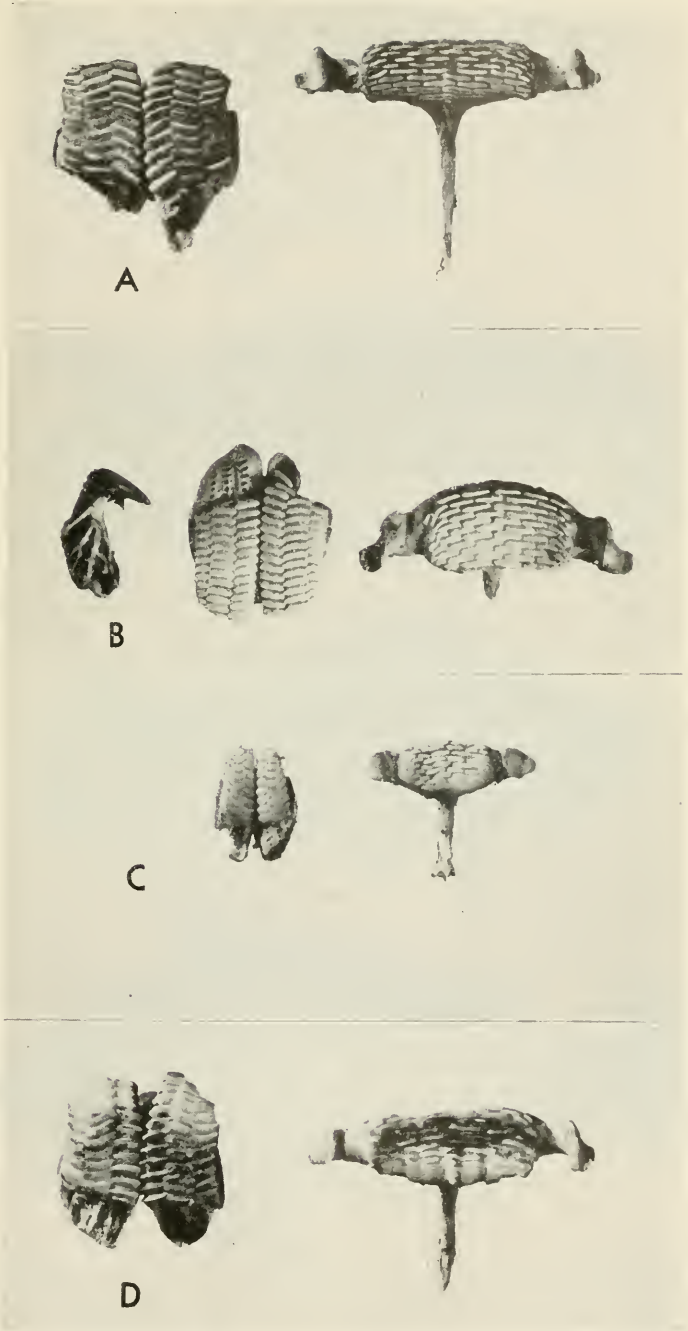
Pharyngeal mill of the genus *Scarops:* A, *S. perrico*, holotype, USNM 38328; B, *S. perrico* (=holotype of *C. microps*), USNM 87548; C, *S. jordani*, USNM 55501.



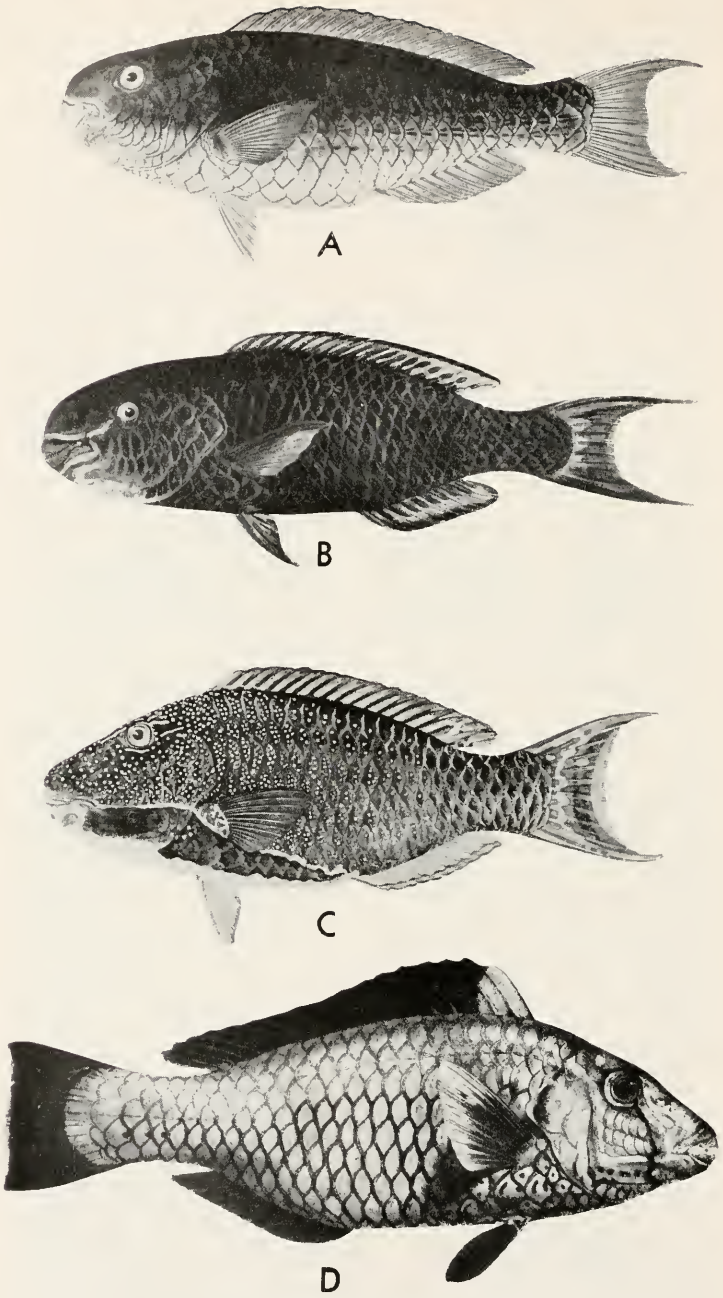
Pharyngeal mill: A, *Scarus aeruginosus*, USNM 157047; B, *S. scaber*, USNM 157123; C, *S. lepidus*, USNM 147237; D, *Scarops rubroviolaceus*, USNM 147267.



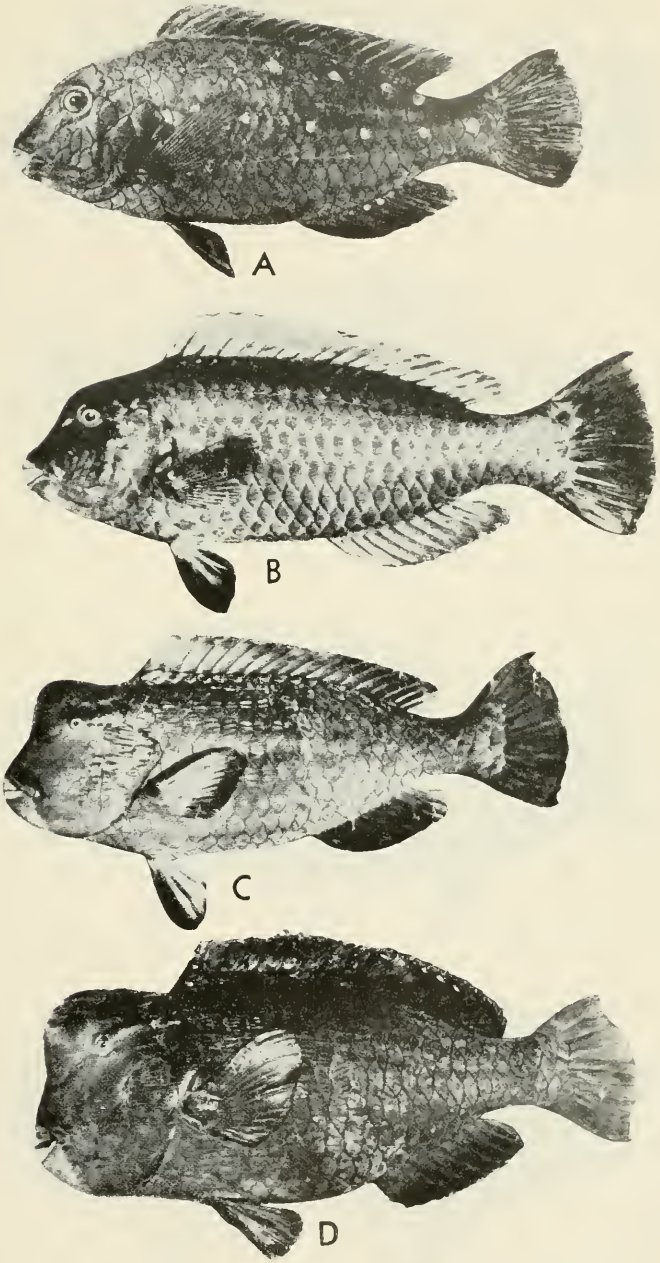
Pharyngeal mill: A, *Leptoscarus vaigiensis*, USNM 150224; B, *Sparisoma chrysopterum*, USNM 16801; C, *S. abildgaardi*, USNM 35063; D, *Euscarus cretensis*, USNM 94518.



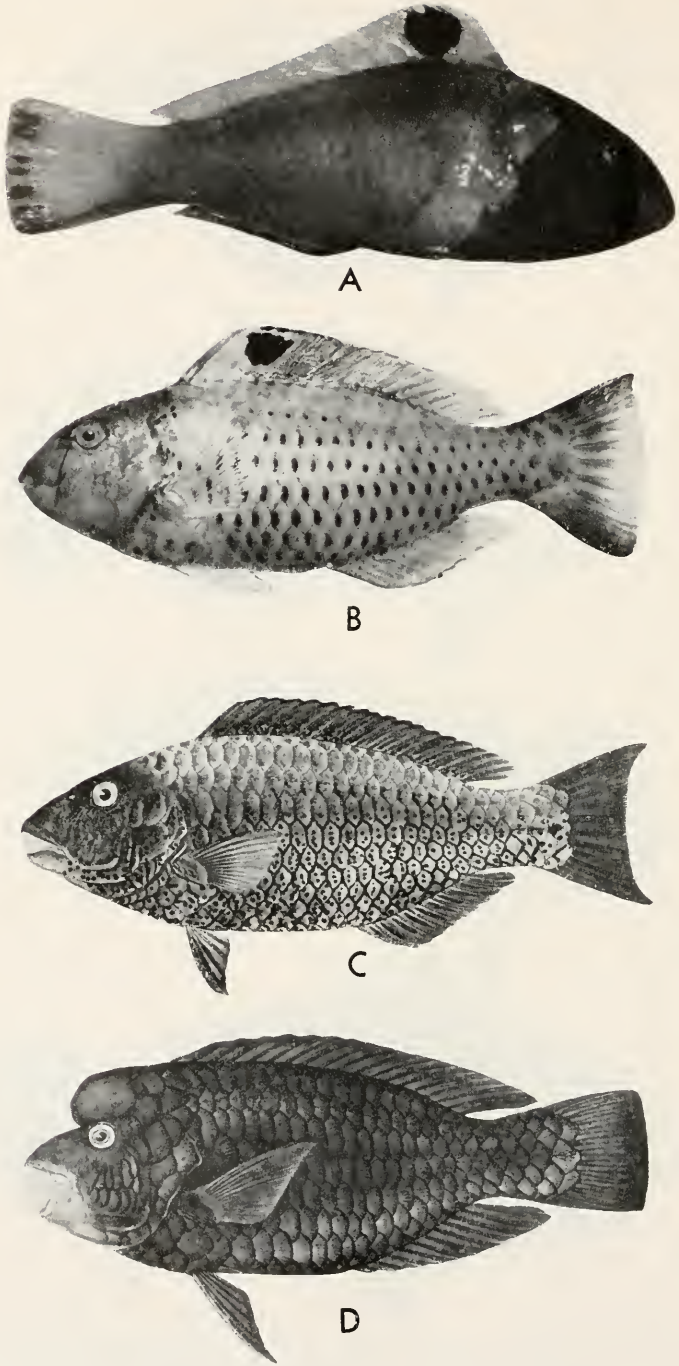
Pharyngeal mill: A, *Calotomus japonicus*, USNM 76311; B, *C. spinidens*, USNM 160437; C, *Cryptotomus roseus*, USNM 117120; D, *Nicholsina denticulatus*, USNM 128016.



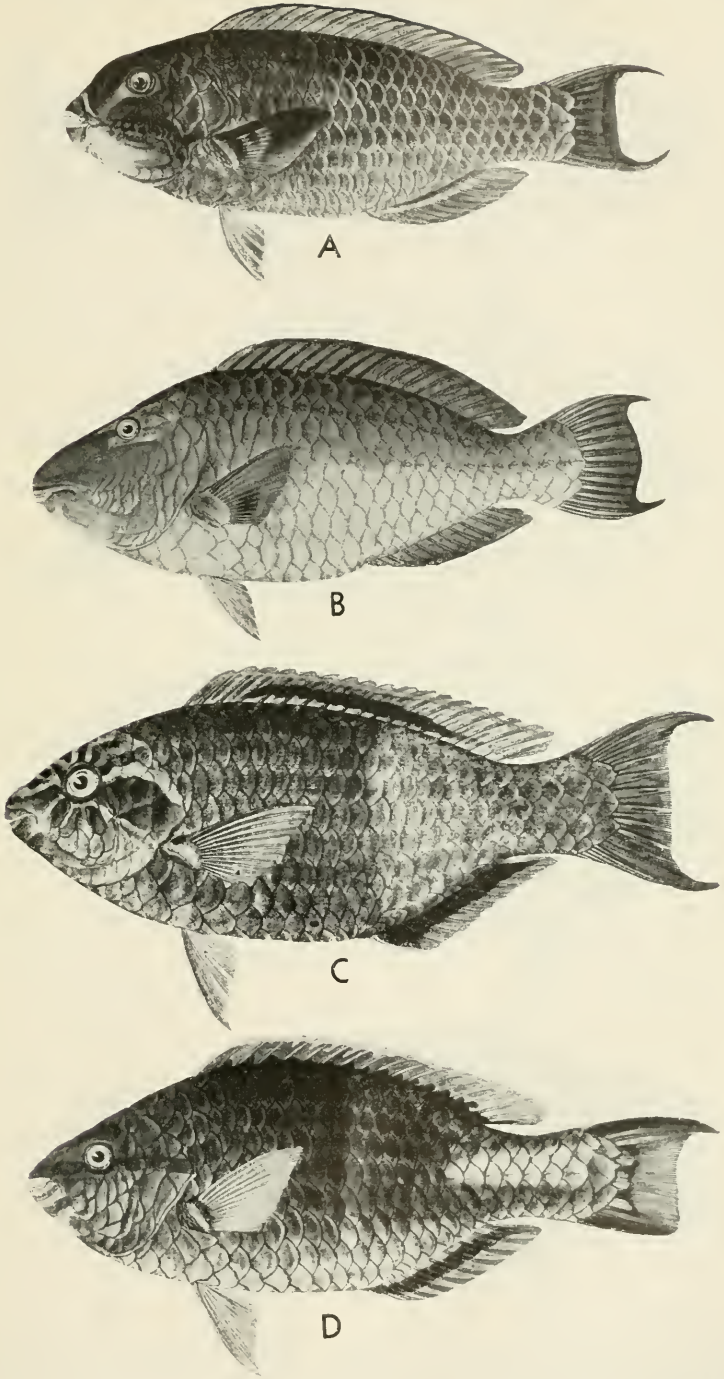
A, *Scarops rubroviolaceus*, photograph of Philippine *Albatross* color drawing, USNM 112219; B, *S. jordani*, after Jordan and Evermann (Bull. U. S. Fish Comm., vol. 23 (1903), pl. 44, 1905); C, *Chlorurus pulchellus*, photograph of Philippine *Albatross* color drawing; D. *C. nigripinnis*, after Playfair and Günther (Fishes of Zanzibar, pl. 15, fig. 2, 1866).



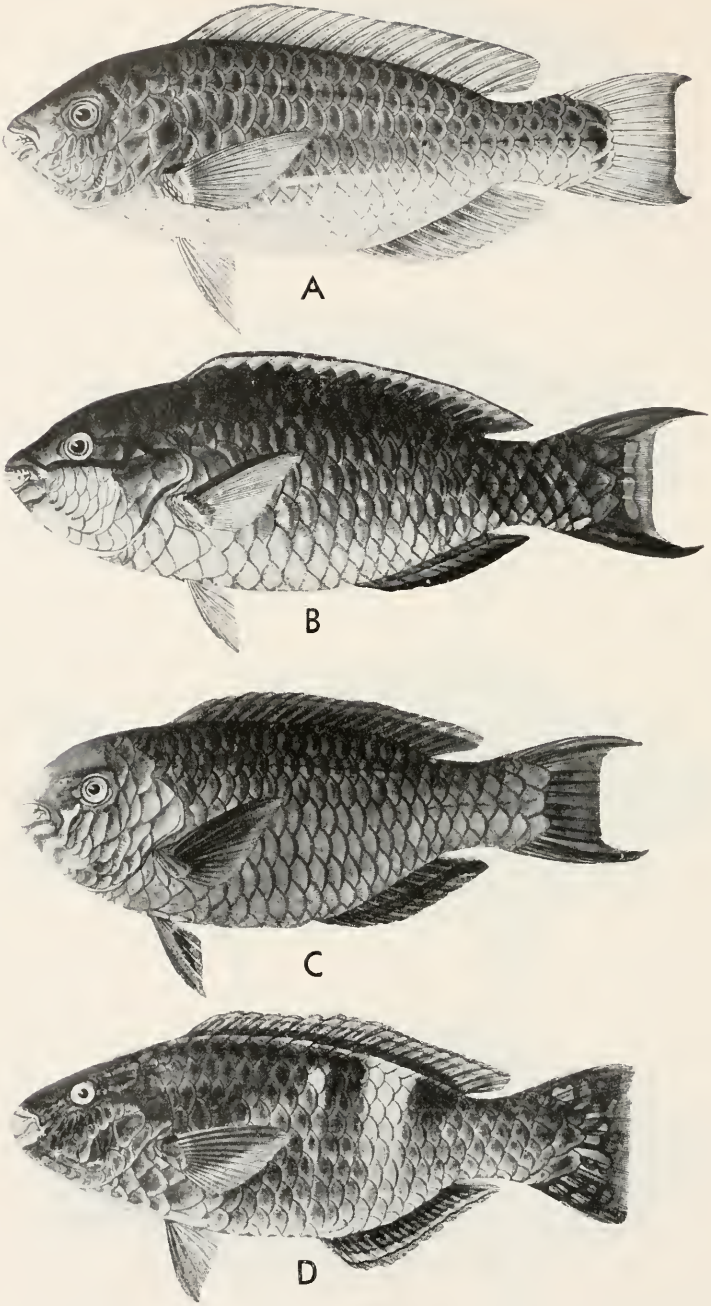
Chlorurus gibbus, after J. L. B. Smith (Ann. Mag. Nat. Hist., ser. 12, vol. 6, pls. 15, 16, 1953): A, juvenile; B, young adult; C, adult; D, large adult.



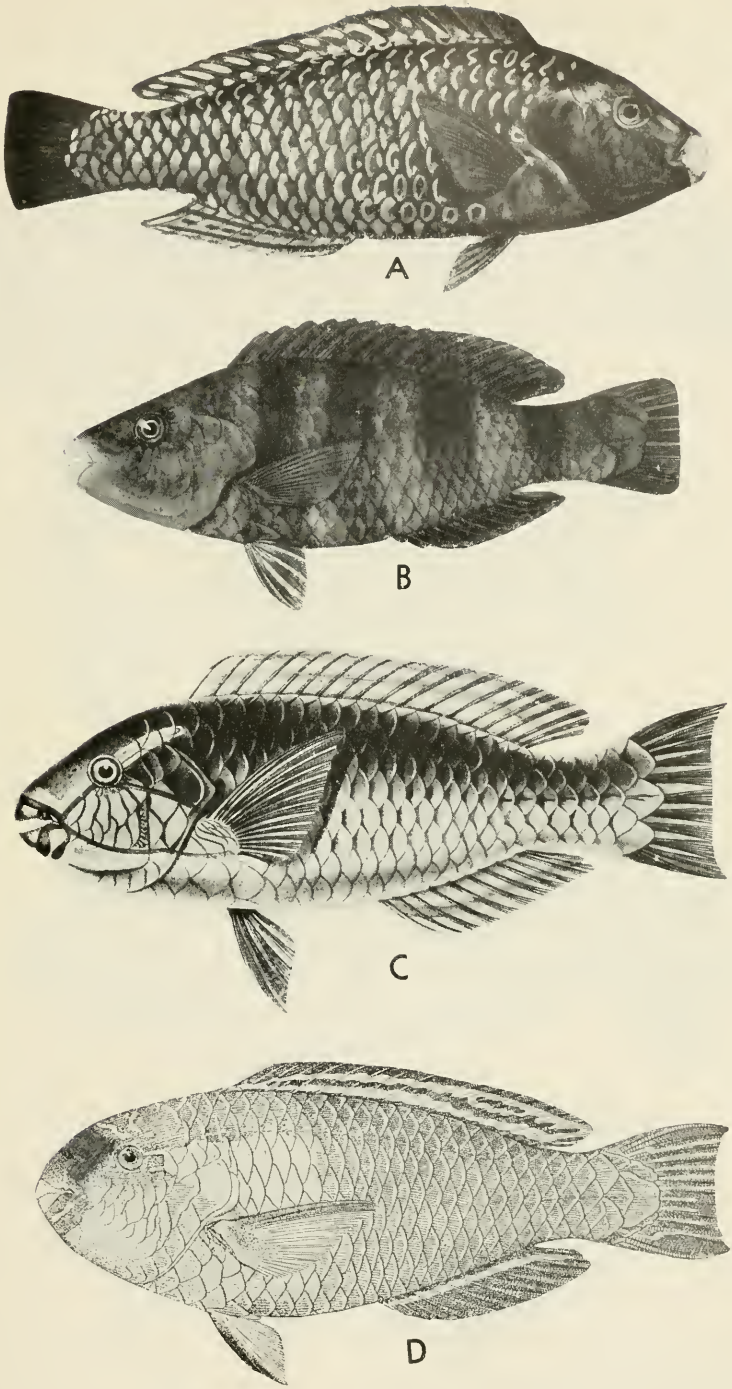
A, *Chlorurus bicolor*, juvenile; B, *C. bicolor*, young; both from Bikini Kodachromes; C, *C. bicolor*, photograph of Philippine *Albatross* color drawing; D, *Scarus* (*Ypsiscarus*) *oedema*, photograph of Philippine *Albatross* color drawing, based on USNM 111224 and 112232.



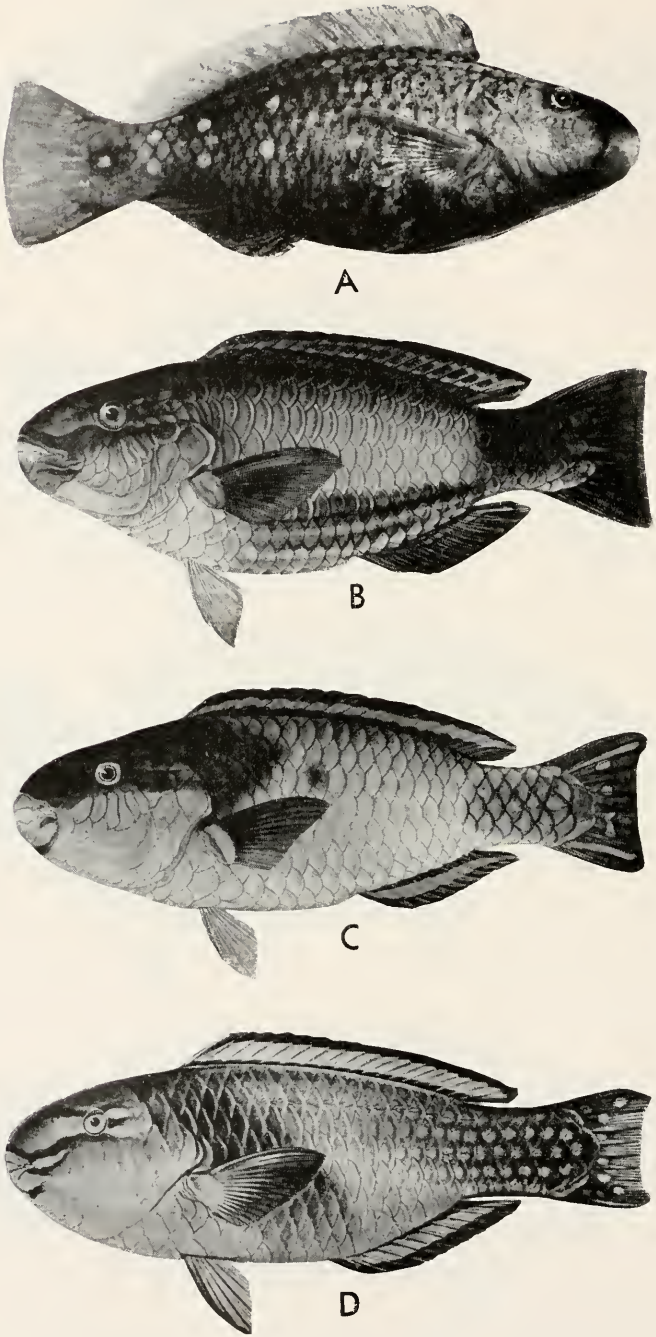
Photographs of Philippine *Albatross* color drawings: A, *Scarus microrhinos*, USNM 112228; B, *S. harid*, USNM 112218; C, *S. javanicus*, USNM 147224; D, *S. flavipectoralis*, new species, holotype, USNM 112217.



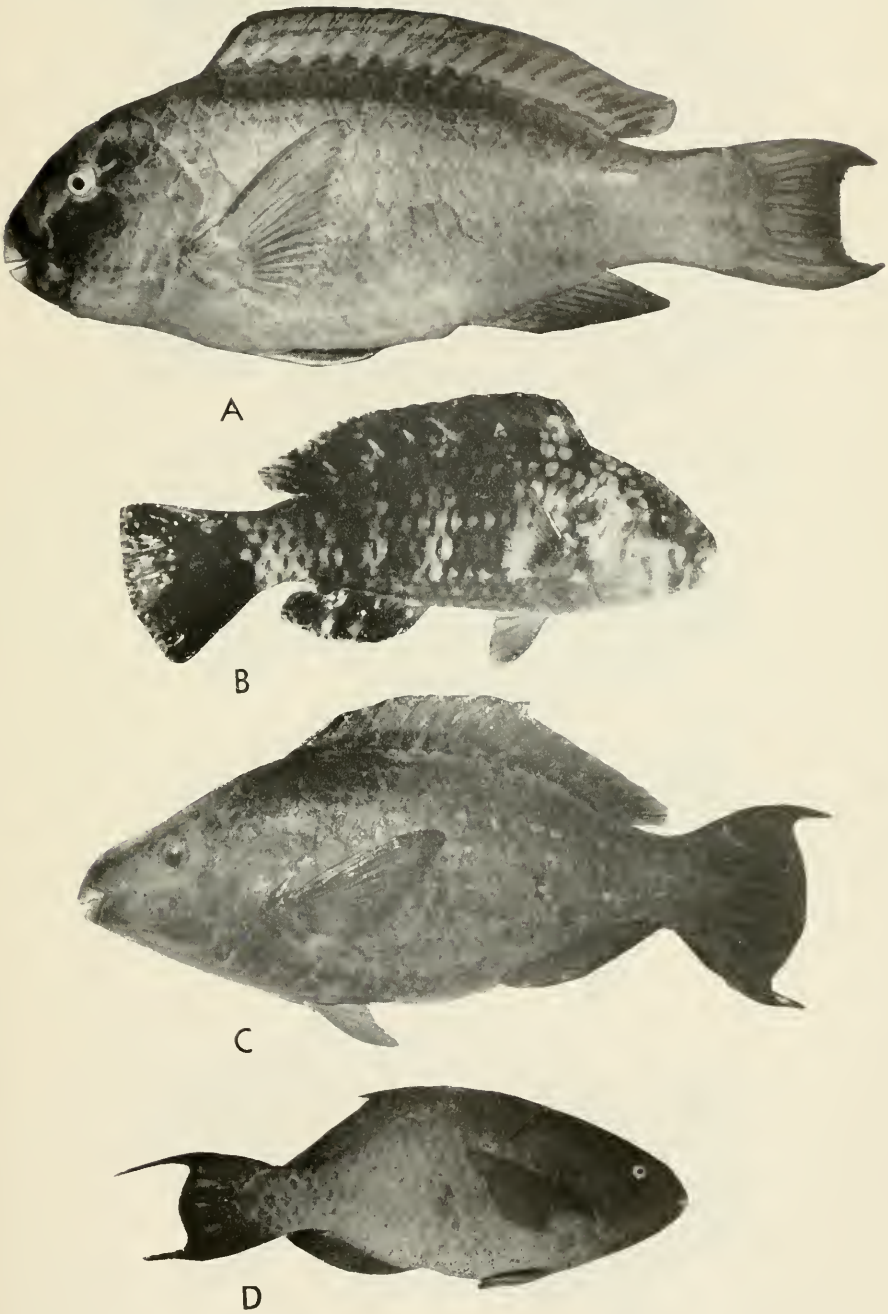
Photographs of Philippine *Albatross* color drawings: A, *Scarus dubius*, USNM 112230 and 151032; B, *S. lunula*, USNM 112215; C, *S. formosus*, USNM 112216 and 112226; D, *S. schlegeli*, USNM 160252.



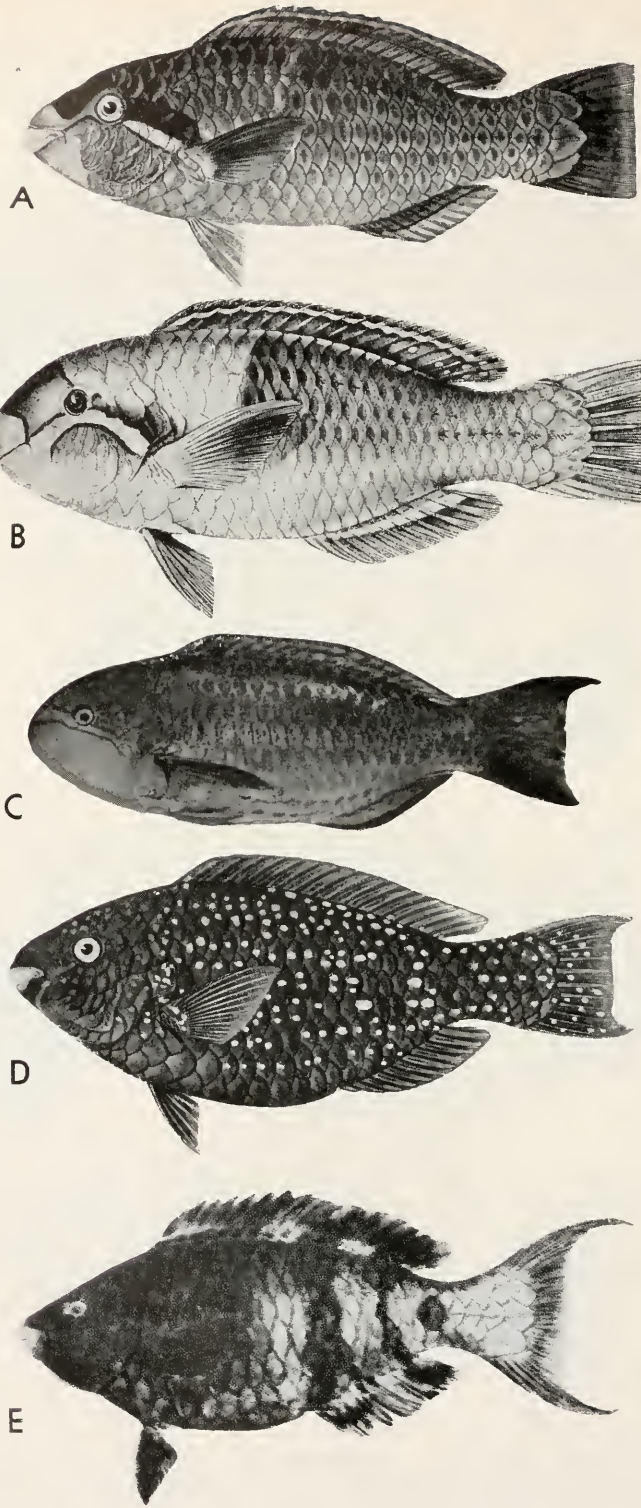
A, *Scarus cyanescens*, after Playfair and Günther (Fishes of Zanzibar, pl. 15, fig. 1, 1866); B, *S. rhoduropterus*, photograph of Philippine *Albatross* color drawing, USNM 146944; C, *S. bleekeri*, after Bleeker (Atlas ichthyologique . . . , vol. 1, pl. 6, fig. 3, 1862); D, *S. bowersi*, retouched after Snyder (Proc. U. S. Nat. Mus., vol. 42, pl. 46, fig. 2, 1912).



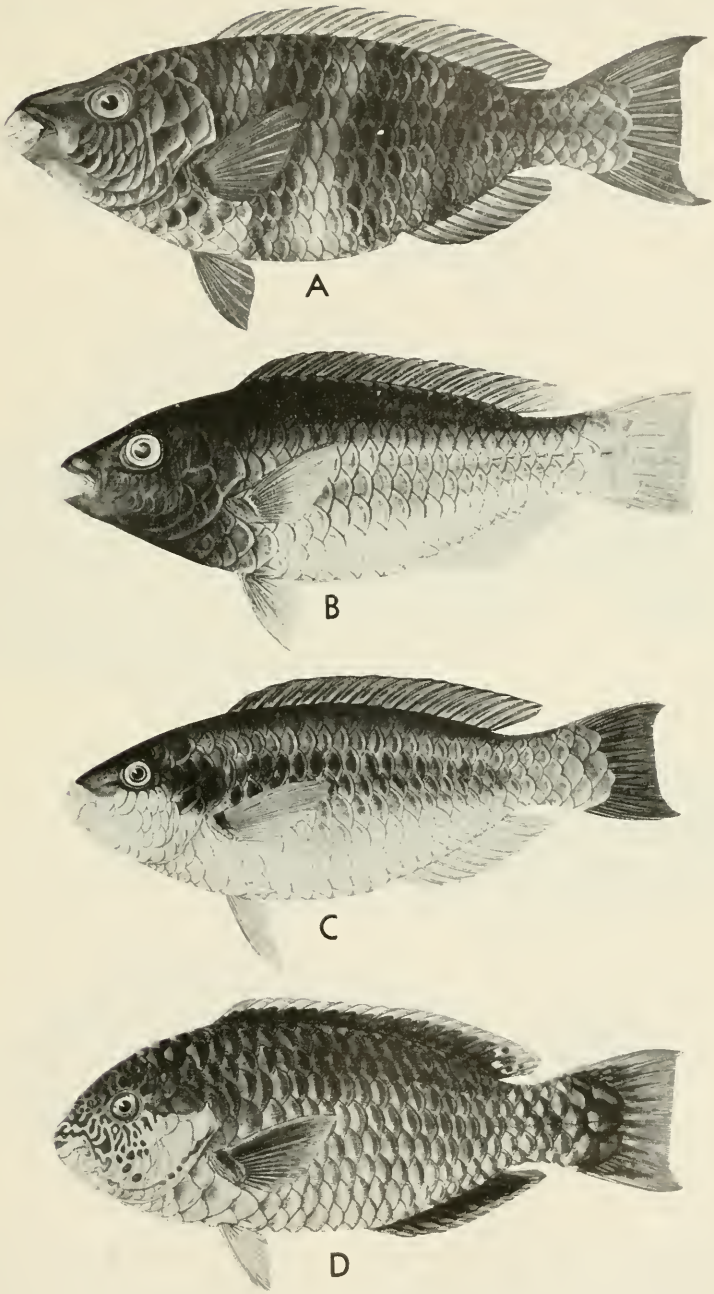
A, *Scarus sordidus*, immature, from Bikini Kodachrome; B, *S. sordidus*, adult, photograph of Philippine *Albatross* color drawing, USNM 160284 and 160341; C, *S. capistratoides* photograph of Philippine *Albatross* color drawing, USNM 157323; D, *S. capistratoides*, after *Callejodon abacurus* Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25, pl. 33, 1906).



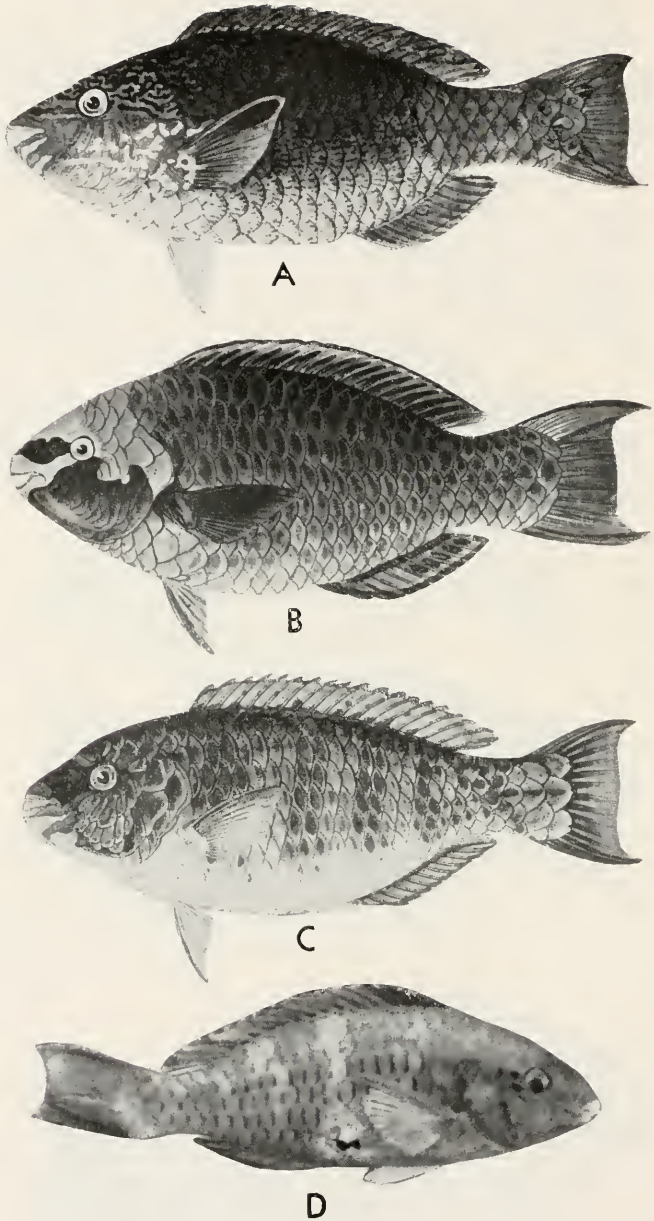
Photographs from Bikini Kodachromes: A, *Scarus jonesi;* B, *S. brevifilis*, small young; C, *S. brevifilis*, adult; D, *S. brevifilis*, large adult.



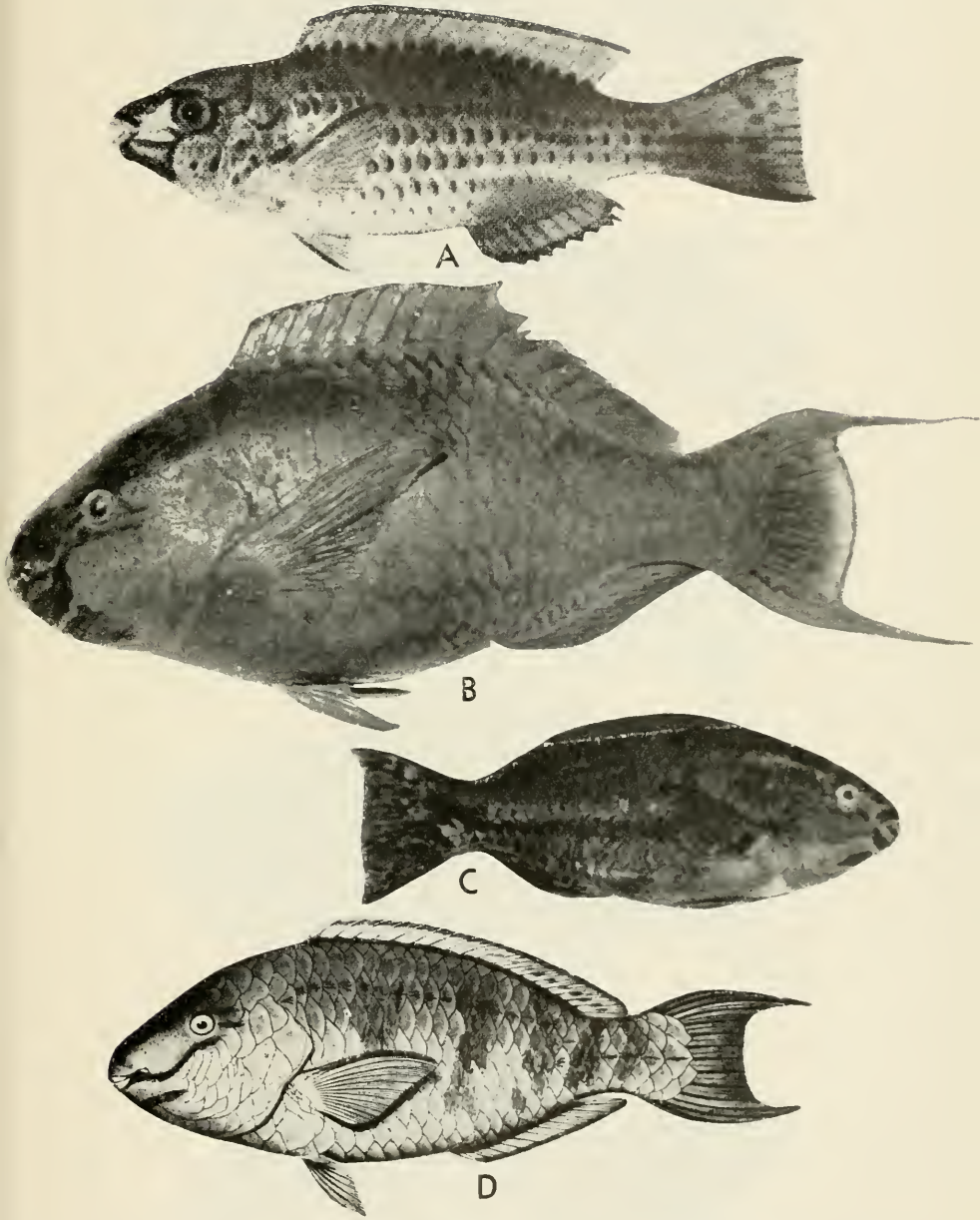
A, *Scarus dimidiatus*, photograph of Philippine *Albatross* color drawing, USNM 112210; B, *S. dimidiatus*, after *C. fumifrons* Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25, pl. 34, 1906); C, *S. globiceps*, photograph by John Randall; D, *S. singaporensis*, photograph of Philippine *Albatross* color drawing; E, *S. rubrofasciatus* Smith, after J. L. B. Smith (Rhodes Univ. Ichthy. Bull. No. 1, pl. 43,1, 1956).



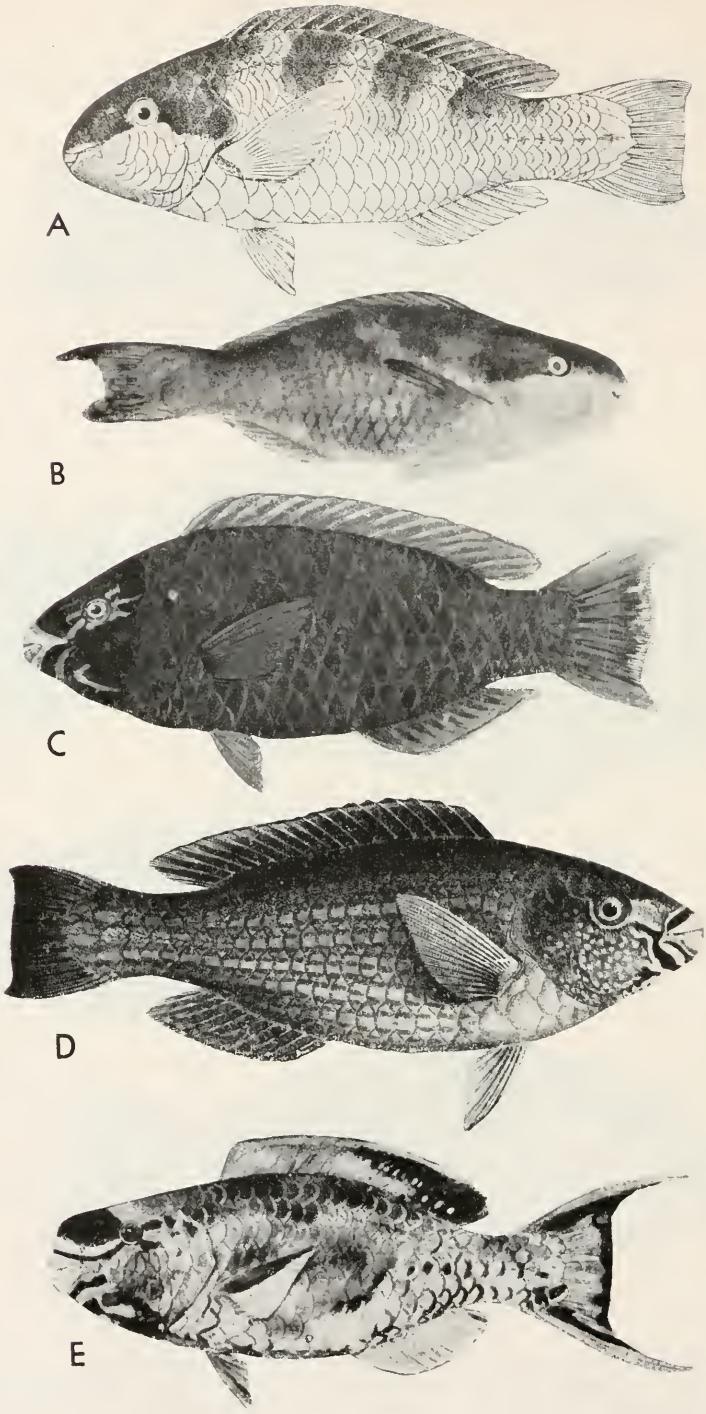
Photographs of Philippine *Albatross* color drawings: A, *Scarus atropectoralis*, new species, USNM 147217 and 157321; B, *S. lepidus*, after *C. viridibusius* Fowler and Bean, paratype USNM 160360; C, *S. lepidus*, USNM 160212 and 147238; D, *S. fasciatus*, USNM 112211 and 112233.



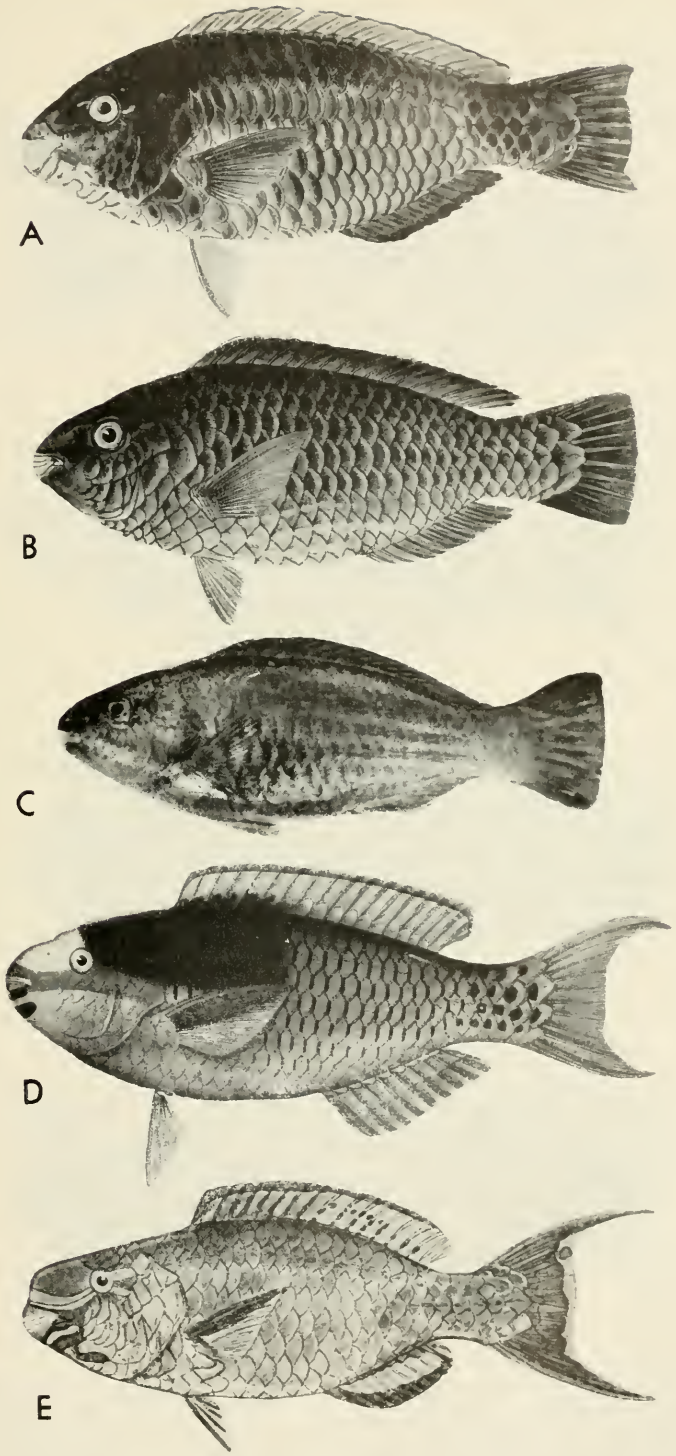
A, *Scarus vermiculatus*, photograph of Philippine *Albatross* color drawing, USNM 89978; B, *S. janthochir*, photograph of Philippine *Albatross* color drawing, USNM 112225, 112222, and 112223; C, *S. ghobban*, photograph of Philippine *Albatross* color drawing, USNM 160120; D, *S. ghobban*, after a Kodachrome by John Randall.



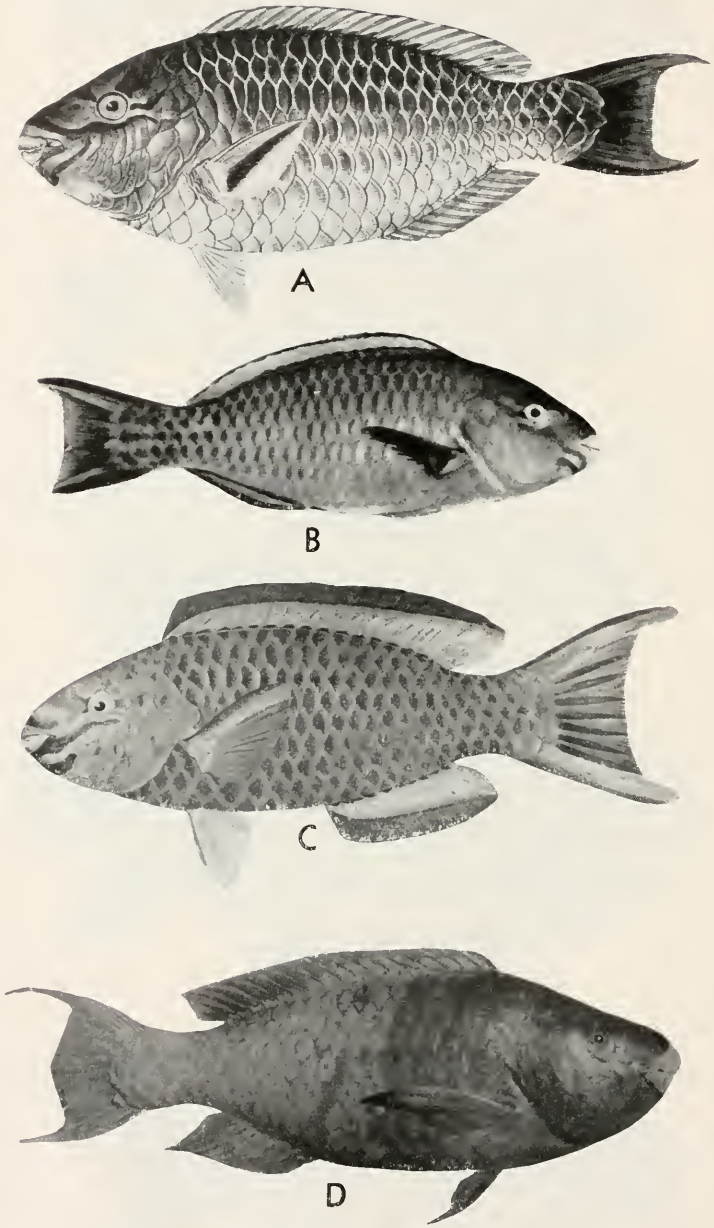
A, *Scarus guttatus*, after J. L. B. Smith (Sea fishes of southern Africa, p. 296, pl. 62, fig. 824, 1949); B, *S. chlorodon*, after a Bikini Kodachrome; C, *S. chlorodon*, after a Kodahcrome by John Randall; D, *S. noyes* Heller and Snodgrass (Proc. Washington Acad. Sci., vol. 5, pl. 9, 1903).



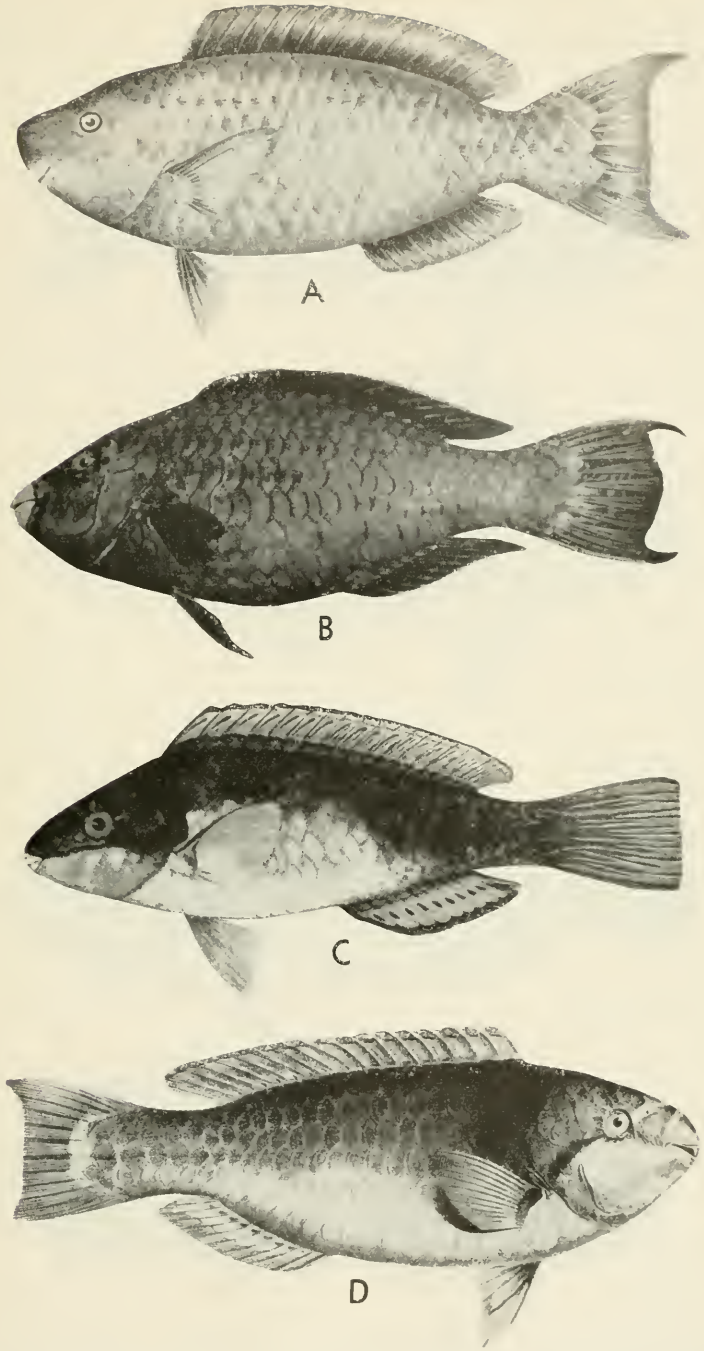
A *Scarus scaber*, after *C. zonularis* Jordan and Seale (Bull. U. S. Bur. Fish., vol. 25, fig. 60, 1906); B, *S. oviceps*, after Kodachrome by John Randall; C, *S. niger*, photograph of Philippine *Albatross* color drawing; D, *S. madagascariensis*, after Steindachner (Sitzb. Akad. Wiss. Wien , vol. 96, pt. 1, p. 61, pl. 2, fig. 1, 1887); E, *S. africanus* (Smith), after J. L. B. Smith (Mem. Mus. Dr. Alvaro de Castro, No. 3, fig. 26, 1955).



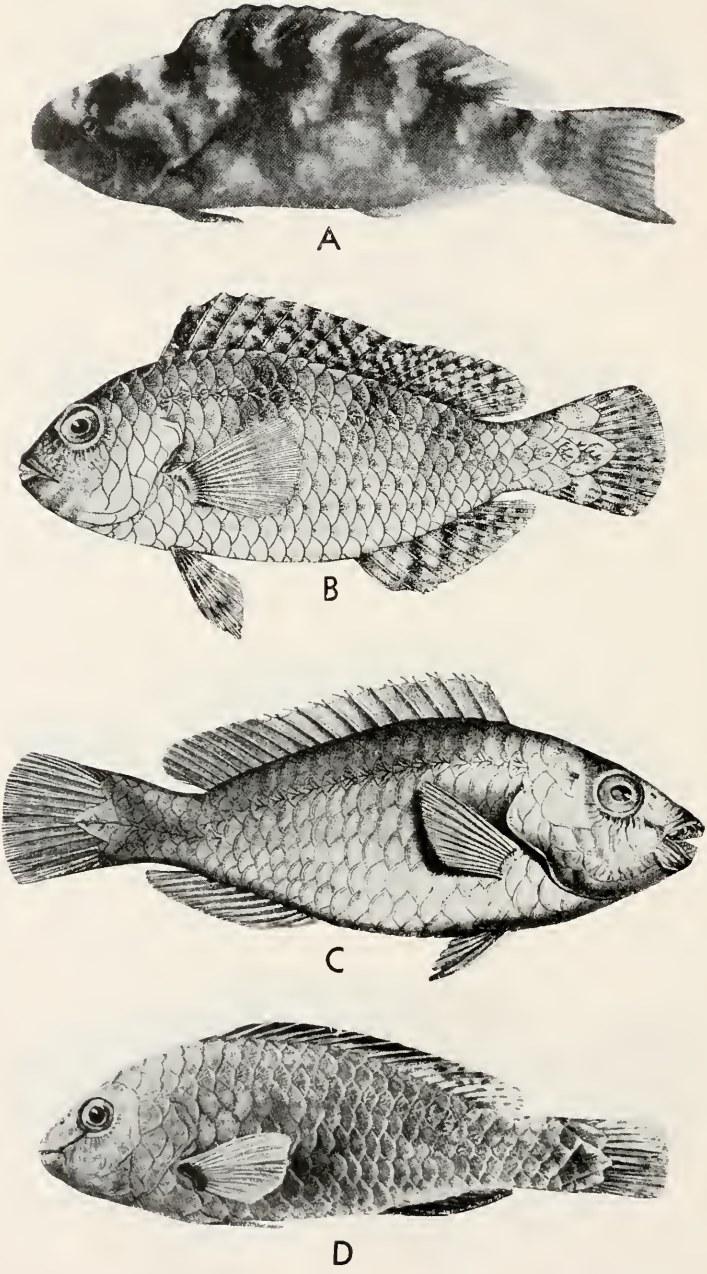
A, *Scarus blochi*, photograph of Philippine *Albatross* color drawing; B, *S. aeruginosus*, photograph of Philippine *Albatross* color drawing, USNM 112231 and 157047; C, *S. randalli*, new species, after a Kodachrome by John Randall; D, *S. pectoralis* Günther (Journ. Mus. Godeffroy, vol. 8, pl. 158, 1909); E, *S. africanis* Smith, after J. L. B. Smith (Rhodes Univ. Ichthy. Bull. No. 1, pl. 42,A, 1956).



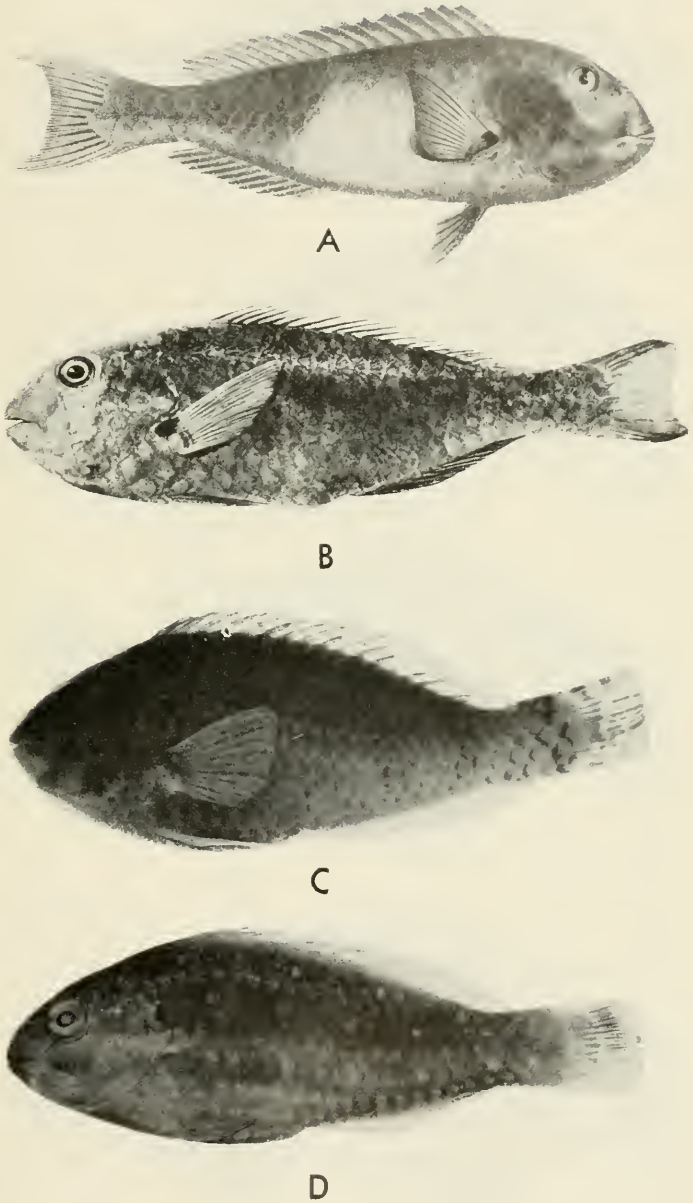
A, *Scarus dussumieri*, photograph of Philippine *Albatross* color drawing, USNM 112229; B, *S. dussumieri*, after a Kodachrome by John Randall; C, *S. vetula*, after Evermann and Marsh (Bull. U. S. Fish Comm., vol. 20, pl. 31, 1902); D, *S. guacamaia*, courtesy of Dr. Daniel Merriman, Yale University, black tip of pectoral fin is a dark shadow.



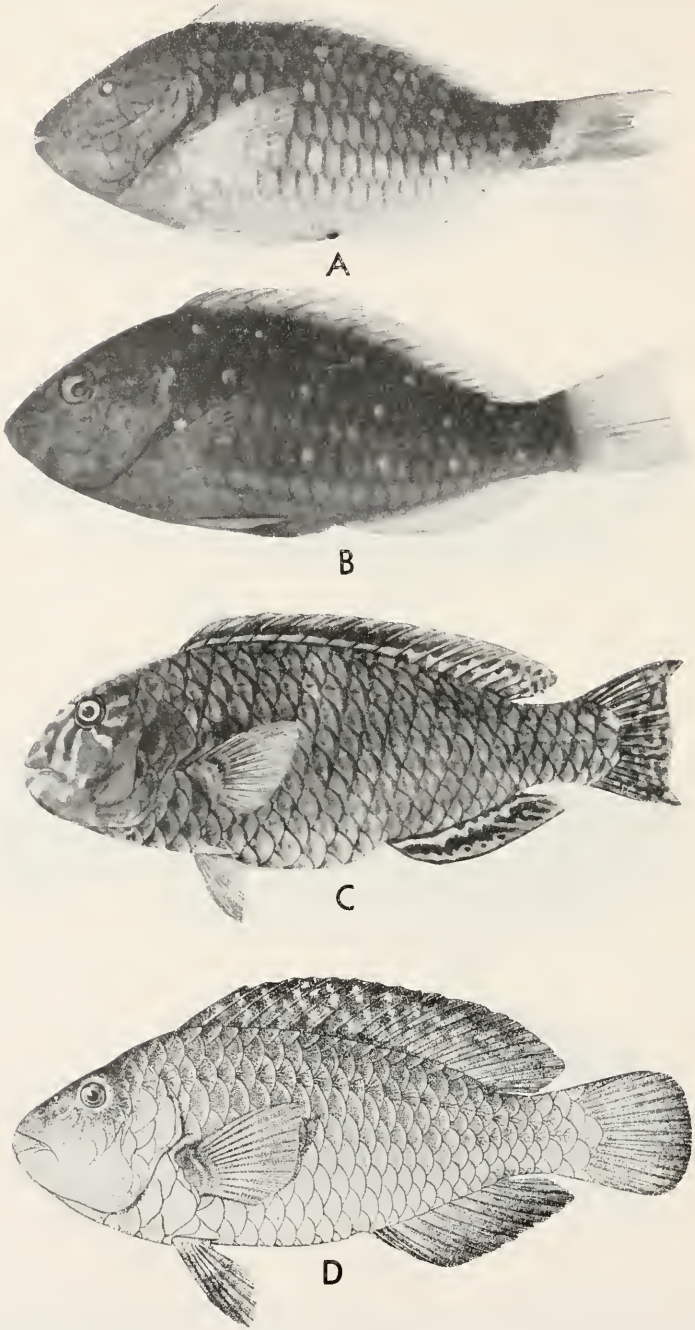
A, *Scarus coeruleus*, after Evermann and Marsh (Bull. U. S. Fish Comm., vol. 20, pl. 32, 1902) adult; B, *S. coelestinus*, courtesy of Dr. Daniel Merriman, Yale University; C, *S. croicensis* (=*S. punctulatus*), after Chute (Guide to the John G. Shedd Aquarium, fig. 714, 1935); D. *S. hoefleri*, after Steindachner (Denkschr. Akad. Wiss. Wien, vol. 44, pl. 6, fig. 2, 1881).



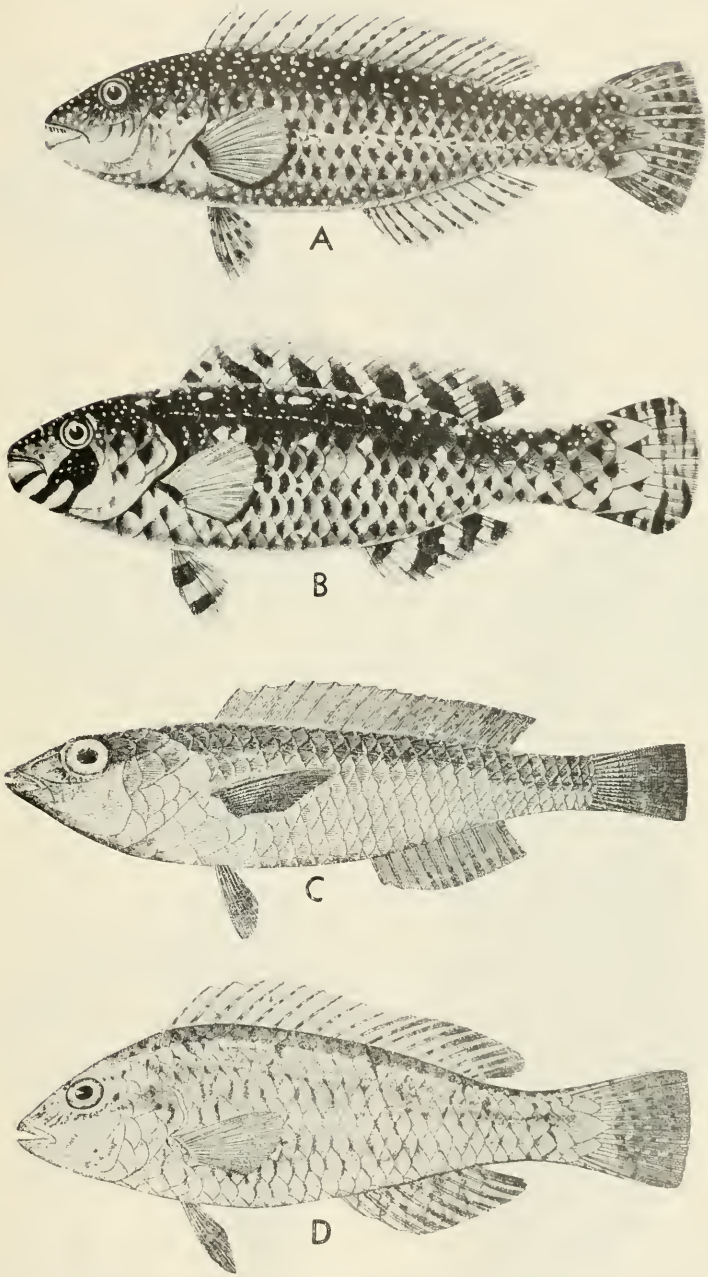
A, *Scarus coeruleus*, after Chute (Guide to the John G. Shedd Aquarium, fig. 713, 1935), immature; B, *Scaridea zonarcha*, after Jenkins (Bull. U. S. Fish Comm., vol. 22, p. 468, fig. 26, 1903); C, *Sparisoma radians*, after Steindachner (Ver. Zool.-Bot. Ges. Wien, vol. 13, pl. 24, fig. 2, 1863), female, note dentition; D, *S. radians* after Meek and Hildebrand (Marine fishes of Panama, vol. 3, pl. 73, 1928), male.



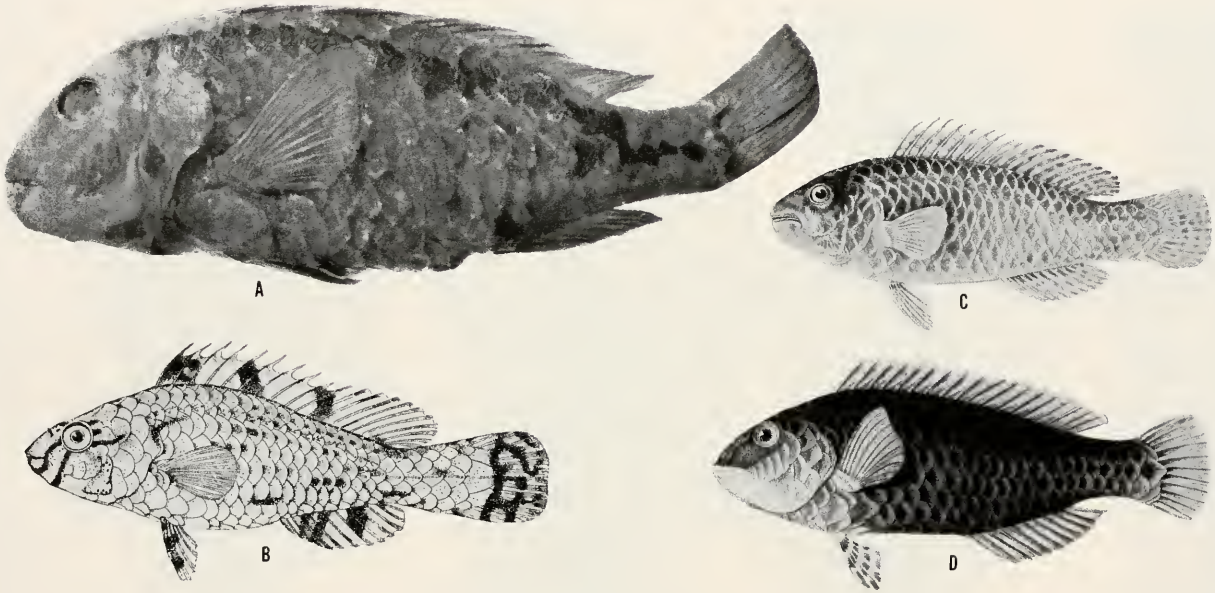
A, *Sparisoma axillaris* after Steindachner (Sitzungsb. Akad. Wiss. Wien, vol. 77, pl. 3, 1878); B, *S. chrysopterum*, after *S. elongatum* (Meek and Hildebrand, Marine fishes of Panama, vol. 3, pl. 74, fig. 2, 1928); C, *S. rubripinnae*, USNM 144890, half grown; D, *S. rubripinnae*, USNM 118956, young.



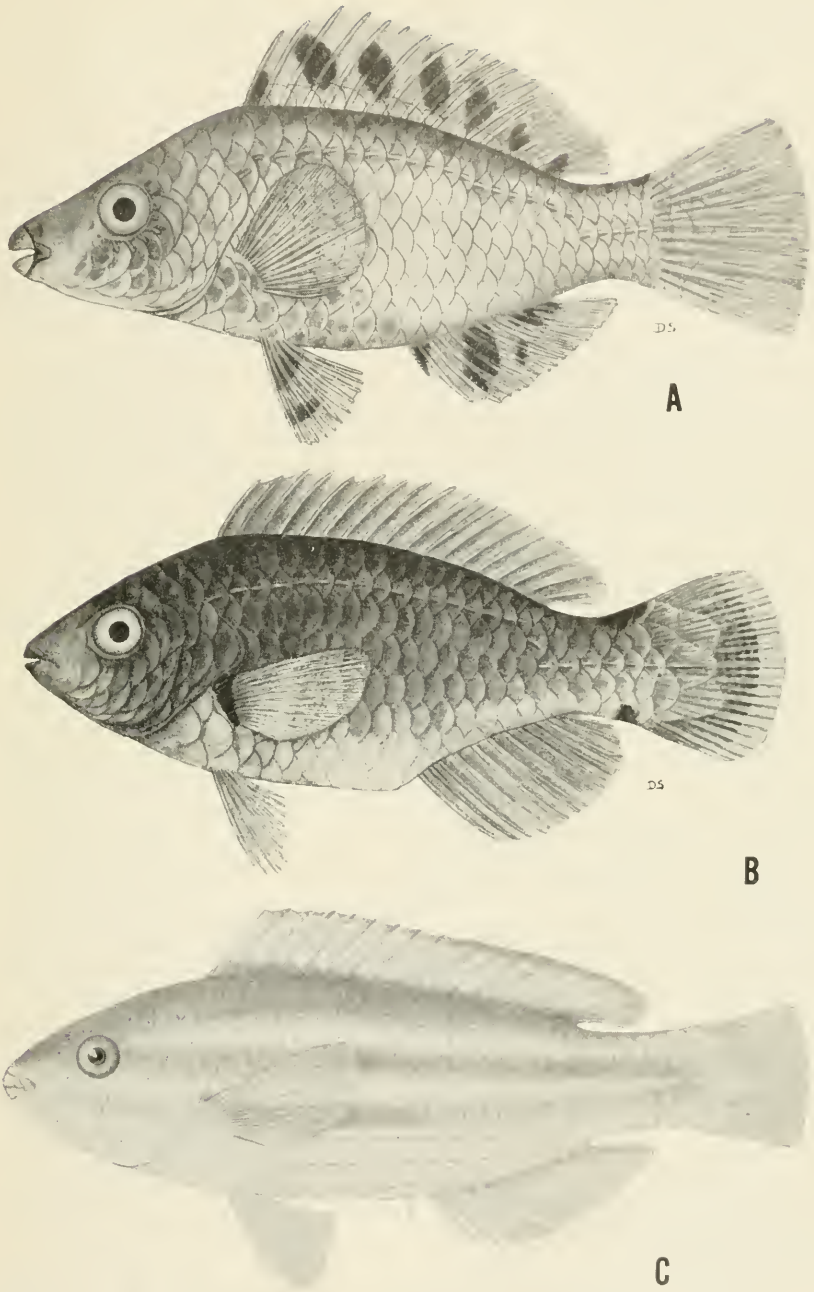
A, *Sparisoma abildgaardi*, USNM 117112, adult; B, *S. abildgaardi*, USNM 89670, half grown; C, *Calotomus spinidens*, photograph of Philippine *Albatross* color drawing, USNM 160437; D, *C. japonicus*, after *C. cyclurus* Jenkins (Bull. U. S. Fish Comm., vol. 22, p. 466, fig. 24, 1903).



A, *Leptoscarus vaigiensis*, male, after Bleeker (Atlas ichthyologique . . . , vol. 1, pl. 1, fig. 2, 1862); B, *L. vaigiensis*, female, after Bleeker (Atlas ichthyologique . . . , vol. 1, pl. 1, fig. 3, 1862); C, *Cryptotomus roseus*, after Cope (Trans. Amer. Philos. Soc., vol. 14, p. 462, fig. 1, 1871); D, *Nicholsina ustus*, after Jordan and Evermann (U. S. Nat. Mus. Bull. 47, pt. 4, pl. 242, fig. 608, 1900).



A, *Euscarus strigatus*, holotype, photograph courtesy of British Museum; B, *Nicholsina denticulatus*, young, after Harry (Amer. Midl. Nat., vol. 43, p. 148, fig. 3, 1950); C, *N. denticulatus*, holotype, after Evermann and Radcliffe (U. S. Nat. Mus. Bull. 95, pl. 12, fig. 1, 1917); D, *Euscarus cretensis*, after Cuvier and Valenciennes (Histoire naturelle des poissons, vol. 14, pl. 400, 1839).



A, *Scarus randalli*, new species, specimen 45 mm. in standard length from Palmyra Island, August 17, 1951, collected by Dr. R. R. Harry; B, *S. niger*, a specimen 69 mm. in standard length from Ifaluk Atoli, collected by Dr. R. R. Harry (both drawn by Dorothea B. Schultz); C, *S. croicensis*, after USNM 10175 and 133735 (drawing by Aime M. Awl).

Index

(Page numbers of principal entries and names of new genera and species in *italics*.)

abacurus, Callyodon, 71, 74
abbotti, Sparisoma, 113
abildgaardi, Sparisoma, 4, 6, 111, 113, 120, *121*
  Sparus, 110, 121
acutus, Scarus, 103
aerosa, Scaridea, 110
aeruginosus, Pseudoscarus, 69, 96
  Scarus, 4, 6, 12, 32, 44, 46, 54, *96*
africanus, Callyodon, 75
  Margaritodon, 75
  Scarus, 4, 32, 40, *75*
ahula, Scarus, 36, 57, 59
albipunctatus, Callyodon, 69
alternans, Scarus, 106, 109
altipinnis, Pseudoscarus, 86
amplus, Scarus, 122
angustinus, Pseudoscarus, 11
apridentatus, Callyodon, 51
arabicus, Pseudoscarus, 11
aracanga, Pseudoscarus, 12, 107
  Scarus, 12, 107
arcuatus, Scarus, 11
atomarius, Scarus, 113
atropectoralis, Scarus, 5, 32, 41, *79*
aureoruber, Sparus, 122
auritius, Scarus, 126
auritus, Scarichthys, 126
aurofrenatum, Sparisoma, 1, 3, 6, 111 (fig.), 112 (fig.), *115*, 121
aurofrenatus, Scarus, 115
auropunctatus, Callyodon, 128, 129
australianus, Scarus pyrrostethus, 84
axillaris, Scarus, 117
  Sparisoma, 6, 13, 112, *117*
azureus, Scarus, 6, 11, 32, 43, 44 (fig.), *89*, 91

balia, Scaridea, 110
balinensis, Pseudoscarus, 56, 61
  Scarus, 61
barborus, Scarus, 57, 59
bataviensis, Callyodon, 64
  Pseudoscarus, 64
  Scarus, 64, 65
  Xanothon, 64
bennetti, Scarus, 12, 54, 96
beryllinus, Cryptotomus, 128
  Nicholsina, 4
bicolor, Cetoscarus, 27
  Chlorurus, 4, 5, 20, 26, *27*
  Pseudoscarus, 27
  Scarus, 27
bipallidus, Callyodon, 131
  Scarus, *131* (fig.)
  Xanothon, 30, 131
bleekeri, Callyodon, 12, 68
  Callyodontichthys, 12, 110, 113
  Scarus, 5, 13, 31, 38, *68*
blochi, Scarus, 6, 13, 32, 46, *95*
Bolbometopon, 25
  muricatus, 26
bollmani, Scarus, 107
borborus, Callyodon, 57
bottae, Scarus, 126
bowersi, Callyodon, 72
  Scarus, 5, 31, 39, *72*, 73, 74
brachiale, Scarus, 13
brachialis, Scarus, 120
brachysoma, Callyodon, 124
brachyvarius, Scarus, 117
brevifilis, Pseudoscarus, 76
  Scarus, 4, 5, 32, 40, *76*, 79
brighami, Scarus, 72
brunneus, Scarus, 62, 63

caeruleo-punctatus, Scarus, 126
caerulescens, Scarus, 11
californiensis, Pseudoscarus, 91
  Scarus, 4, 6, 32, 44, 45 (fig.), 90, *91*
Calliodon, 30, 123, 124, 126
  chlorolepsis, 126
  lineatus, 30, 106, 108
  subg., 126

396816—58——12

Callyodon, 30
abacurus, 71, 74
africanus, 75
albipunctatus, 69
apridentatus, 51
auropunctatus, 128, 129
bataviensis, 64
bipallidus, 131
bleekeri, 12, 68
borborus, 57
bowersi, 72
brachysoma, 124
carolinus, 124
caudofasciatus, 80, 92
compressus, 91
cyanogrammus, 69, 71
dubius, 62, 96, 97
elerae, 100
erythacus, 62
falcipinnis, 75
flavescens, 110
forsteri, 81
frenatus, 52
fumifrons, 74
fuscocuneus, 92
genistriatus, 124
ghobban, 84
globiceps, 75
guttatus, 85
hadji, 95
hornbosteli, 62
hypselosoma, 124
improvisus, 78
janthochir, 55, 83
japonicus, 125
kelloggi, 56
latax, 72
latifasciatus, 81
laxtoni, 81
lazulinus, 100
lineatus, 30
lineolabiatus, 93
lunula, 54
macleayi, 26
madagascariensis, 94
malindiensis, 96, 97
maoricus, 93
margarita, 13, 70, 107, 109
microps, 23, 24 (fig.)
moluccensis, 125
mus, 100
mutabilis, 92
niger, 93
Callyodon—Continued
oedema, 47, 48
ogos, 52
pectoralis, 83
philippinus, 95
pindae, 96
psittacus, 13, 114
pyrrhurus, 62
retractus, 128
rostratus, 69
ruberrimus, 21
rubrofasciatus, 79
rubroviolaceus, 21
sandwicensis, 124
scaber, 92
scriptus, 27
shimoniensis, 26
singaporensis, 78
speigleri, 100
spinidens, 125
ultramarinus, 48
upolensis, 56, 97
ustus, 128, 129
vermiculatus, 76, 82
verweyi, 30, 54
viridibusius, 81
viridifucatus, 54, 56
waitei, 86, 87
waigiensis, 124
zonularis, 92
Callyodontichthys, 110
bleekeri, 12, 110, 113
Callyodontidae, 14
Calotomus, 4, 6, 7, 10, 17, *123* (key)
cyclurus, 125
irradians, 124
japonicus, 4, 6, 123, *125* (table)
snyderi, 124
spinidens, 4, 6, 13, 123, *124*, 125 (table)
xenodon, 4, 123, 124
calus, Scarus, 21
canariensis, Scarus, 130
cantori, Pseudoscarus, 85
capistratoides, Pseudoscarus, 74
Scarus, 5, 31, 39, 63, 71, *74*
Xanothon, 64, 74
capistratus, Scarus, 11
capitaneus, Scarus, 66
Xanothon, 66
carifanus, Xanothon, 62
carolinus, Callyodon, 124

catesbaei, Scarus, 114
catesbyi, Scarus, 114
caudofasciatus, Callyodon, 80, 92
Pseudoscarus, 92
Scarus, 59
celebicus, Pseudoscarus, 68
Cetoscarus, 25
bicolor, 27
pulchellus, 28
Chloregaster, 25
chloris, Scarus, 11, 118
chlorodon, Scarus, 5, 32, 43 (fig.), *86*
chloromelas, Pseudoscarus, 66
chlorolepsis, Calliodon, 126
Chlorurus, 4, 5, 10, 16, 18, 20 (table), *25*, 26 (key)
bicolor, 4, 5, 20, 26, *27*
gibbus, 4, 5, 13, 20, *26*, 52
microcheilus, 48
microrhinus, 48
nigripinnis, 4, 20, 26, *29*
pulchellus, 4, 5, 20, 26, *28*
strongylocephalus, 48
chrysopoma, Pseudoscarus, 95
chrysopomus, Scarus, 95
chrysopterum, Scarus, 120
Sparisoma, 4, 6, 13, 113, 119, *120*
circumnotatus, Scarus, 118
coccineus, Scarus, 121
coelestinus, Scarus, 6, 13, 101, 102, 104, *105*
coerulea, Corphyaena, 106
coeruleopunctatus, Scarichthys, 126
Scarus, 126
coeruleus, Scarus, 4, 6, 101, 102, 106
collana, Scarus, 50
collaris, Scarus, 50
compressus, Callyodon, 91
Scarus, 4
Corphyaena coerulea, 106
psittacus, 13, 29
crassiceps, Cryptotomus, 127
cretensis, Euscarus, 4, 6, 12, 13, *130*
Labrus, 12, 129, 130
Scarus, 11, 12, 50, 130
croicensis, Scarus, 1, 3, 4, 6, 12, 13, 30, 101, 102, 106
cruentatus, Scarus, 11
Cryptotomus 4, 6, 7, 10, 17, 119, 123, 124, *127*
beryllinus, 128
crassiceps, 127
roseus, 4, 6, 123, 124, *127*
Cryptotomus-like labrid stock, 8 (graph), 9
cuzamilae, Scarus, 103
cyanescens, Scarus, 4, 31, 37, *66*
cyanognathos, Pseudoscarus, 100
Scarus, 99
cyanogrammus, Callyodon, 69, 71
cyanolene, Sparisoma, 113
cyanotaenia, Pseudoscarus, 64
Scarus, 64
Xanothon, 66
cyanurus, Scarus, 50
cyclurus, Calotomus, 125
cypho, Scarus, 59

denticulatus, Nicholsina, 4, 6, 12, 128, *129*
Scarus, 11, 12
Xenoscarus, 12, 128, 129
dentiens, Scarus, 128
diadema, diadema, 107
dimidiatus, Pseudoscarus, 74
Scarus, 4, 5, 32, 40, *74*
distinctum, Sparisoma, 12, 107, 109, 112, 117
distinctus, Scarus, 115
dubius, Callyodon, 62, 96, 97
Scarus, 4, 5, 12, 23, 31, 34, 37, *54*, 96, 97
dussumieri, Pseudoscarus, 100
Scarus, 6, 11, 32, 47, *100*

elerae, Callyodon, 100
elongatum, Sparisoma, 120, 121
emarginatus, Scarus, 118
emblematicus, Scarus, 107, 109
enneacanthus, Scarus, 11
eques, Pseudoscarus collana, 59
Erychthys, 30
erythacus, Callyodon, 62
Scarus, 62, 63
erythrinoides, Scarus, 116
erythrodon, Scarus, 63, 68
Xanothon, 69
Euscarus, 4, 6, 10, 11, 17, *129*, 130 (key)
cretensis, 4, 6, 12, 13, *130*
strigatus, 4, 6, *130*
evermanni, Scarus, 107, 109

falcipinnis, Callyodon, 75
Pseudoscarus, 75
farrandi, Scaridea, 110
fasciatus, Scarus, 5, 32, 41, 80, *82*

ferrugineus, Scarus, 11
festivus, Scarus, 11, 12, 116
filholi, Pseudoscarus, 64
flavescens, Callyodon, 110
Scarus, 11, 12
Sparisoma, 118, 119
flavipectoralis, Scarus, 5, 31, 34, *52*, 80
flavoguttata, Pseudoscarus troschelii, 69
flavomaculatus, Pseudoscarus, 92
flavomarginatus, Pseudoscarus, 93
Scarus, 12, 107
formosus, Scarus, 5, 31, 35, *56*, 61, 87, 88
forsteni, Pseudoscarus, 81
forsteri, Callyodon, 81
Pseudoscarus, 64
Scarus, 4, 5, 13, 31, 37 (fig.), 62, 63, *64*, 65 (fig.)
fowleri, Xanothon, 52
frenatus, Callyodon, 52
Pseudoscarus, 52, 83
Scarus, 5, 32, 41, 42 (fig.), 52, *83*
Xanothon, 52
frondosus, Scarus, 115, 122
frontalis, Pseudoscarus, 13, 26
Scarus, 11, 13
fumifrons, Callyodon, 74
fuscocuneus, Callyodon, 92
fuscopurpureus, Pseudoscarus forskalii, 62

galena, Scarus, 62, 63
garretti, Pseudoscarus, 84
genistriatus, Callyodon, 124
ghobban, Callyodon, 84
Pseudoscarus, 84
Scarus, 5, 11, 30, 31, 42, *84*, 91
gibbus, Chlorurus, 4, 5, 13, 20, *26*, 52
Scarus, 25, 26
gilberti, Scarus, 64
globiceps, Callyodon, 75
Scarus, 4, 5, 32, 40, *75*, 83
gnathodus, Pseudoscarus, 103
godeffroyi, Pseudoscarus, 86
goldiei, Pseudoscarus, 69
guacamaia, Pseudoscarus, 13
Scarus, 4, 6, 13, 18, 30, 101, 103 (fig.), *104*, 105
guttatus, Callyodon, 85
Scarus, 4, 32, 42 (fig.), 78, 79, *85*
gymnognathus, Pseudoscarus, 68
Scarus, 68

hadji, Callyodon, 95
harid, Hipposcarus, 51
Scarus, 3, 4, 5, 13, 29, 30, 31, 33, 34 (fig.), *50*
haridoides, Scarus, 84
heliotropinus, Pseudoscarus, 21
Hemistoma, subg., 9, 10, 16, 30, 40, 74, 89, 102 (table)
hertit, Scarus, 84
hildebrandi, Scarus, 12, 23, 24 (fig.)
Hipposcarus, 30
harid, 51
hoefleri, Pseudoscarus, 109
Scarus, 6, 101, 102, 109
holocyaneos, Sparus, 106
hoplomystax, Scarus, 113
hornbosteli, Callyodon, 62
hubbsi, Xenoscarus, 129
humeralis, Scarus, 12
hypselopterus, Pseudoscarus, 54
Scarus, 54, 97
hypselosoma, Callyodon, 124

improvisus, Callyodon, 78
insulae st. crucis, Scarus, 106, 108
irradians, Calotomus, 124
ismaillius, Pseudoscarus, 12

janthochir, Callyodon, 55, 83
Pseudoscarus, 83
Scarus, 5, 32, 41, *83*
japonicus, Callyodon, 125
Calotomus, 4, 6, 123, *125* (table)
javanicus, Pseudoscarus, 52
Scarus, 5, 31, 34, *52*
jenkinsi, Scarus, 64
jonesi, Pseudoscarus, 72
Scarus, 5, 31, 39 (fig.), *72*
jordani, Pseudoscarus, 21
Scarops, 4, 5, 11, 19 (fig.), 20, *21*
kelloggi, Callyodon, 56
knerii, Pseudoscarus, 93
kraussi, Scarus, 57

labiosus, Pseudoscarus, 12
Labrus cretensis, 12, 129, 130
lacerta, Scarus, 96
lacrimosus, Scarus, 113
latax, Callyodon, 72
lateralis, Scarus, 120
latifasciatus, Callyodon, 81
latus, Scarus, 50

lauia, Scarus, 5, 31, 35 (fig.), *57*
laxtoni, Callyodon, 81
lazulinus, Callyodon, 100
lepidus, Scarus, 4, 5, 32, 41, 47, 80, *81*
Leptoscarus, 4, 6, 10, 17, *126*
vaigiensis, 4, 6, *126*
Leptoxanus, 126
waigensis, 126
leucostigma, Scarus, 57
leucotaeniata, Scaridea, 69, 71
limbatus, Scarus, 93
lineatus, Calliodon, 30, 106, 108
Callyodon, 30
lineolabiatus, Callyodon, 93
lineolatus, Pseudoscarus, 107, 109
longiceps, Scarus, 50
lorito, Sparisoma, 4, 120
Loro, 30
loro, Scarus, 106
lunula, Callyodon, 54
Scarus, 5, 13, 31, 35 (fig.), *54*
lunulatus, Scarus, 12
lupus, Scarus, 72

macleayi, Callyodon, 26
macrocheilos, Scarus, 50
macrocheilus, Pseudoscarus, 50
maculiceps, Pseudoscarus, 12
maculosus, Scarus, 85
madagascariensis, Callyodon, 94
Pseudoscarus, 93
Scarus, 4, 32, 45, *94*, 131
makaravar, Scarus, 12
malindiensis, Callyodon, 96, 97
maoricus, Callyodon, 93
margarita, Callyodon, 13, 70, 107, 109
Margaritodon, 30
africanus, 75
verweyi, 54
margaritus, Pseudoscarus, 69
Scarus, 13
Xanothon, 69
marshalli, Scarus, 5, 32, 43, *88* (fig.)
maschalespilos, Scarus, 120
mastax, Pseudoscarus, 50
Scarus, 50
melanotis, Scarus, 114
mertensii, Scarus, 12
microcheilos, Pseudoscarus, 48
microcheilus, Chlorurus, 48
microgmathus, Scarus, 82
microps, Callyodon, 23, 24 (fig.)
Scarops, 4
microrhinos, Pseudoscarus, 48
Scarus, 4, 5, 25, 30, 31, 33 (fig.), *48*
microrhinus, Chlorurus, 48
mineofrenatus, Scarus, 115, 116
miniatus, Scarus, 57
moensi, Pseudoscarus, 54
Scarus, 54
moluccensis, Callyodon, 125
moresbyensis, Pseudoscarus, 12
muricatus, Bolbometopon, 26
Pseudoscarus, 26
Scarus, 25, 26
mus, Callyodon, 100
mutabilis, Callyodon, 92
Scarus, 13, 59, 130

naevius, Scarichthys, 126
Scarus, 126
natalensis, Pseudoscarus, 85
Nicholsina, 4, 6, 7, 10, 17, *128* (key)
beryllinus, 4
denticulatus, 4, 6, 12, 128, *129*
ustus, 4, 6, *128*
niger, Callyodon, 93
Scarus, 4, 6, 12, 32, 45, 46 (fig.), 66, *93*, 94
nigrans, Scarus, 12
nigrescens, Scarus, 103
nigripinnis, Chlorurus, 4, 20, 26, *29*
Pseudoscarus, 29
niphobles, Sparisoma, 113
noyesi, Scarus, 4, 6, 11, 32, 44 (fig.), 85, *90*
nuchalis, Scarus, 106
nuchipunctatus, Pseudoscarus, 93
Scarus, 93

obtusus, Scarus, 106
ocellatus, Scarus, 27
octodon, Scaridea, 113
oedema, Callyodon, 47, 48
Scarus, 4, 5, 31, 33, *48*, 67
ogos, Callyodon, 52
oktodon, Scarus, 64
Xanothon, 64
ophthalmistius, Scarus, 27
oviceps, Scarus, 6, 32, 45, 92, *93*
oxybrachius, Scarus, 116

pachycephalum, Sparisoma, 13, 118, 119
paluca, Scarus, 21
papuensis, Pseudoscarus, 12
parvidens, Xanothon, 64

pectoralis, Callyodon, 83
Pseudoscarus, 100
Scarus, 6, 32, 47, 92, *99* (fig.)
pentazona, Pseudoscarus, 60, 92
Scarus, 61
Xanothon, 60
pepo, Scarus, 30, 84
perrico, Scarops, 4, 5, 19, 20, *23*, 24 (fig.)
Scarus, 23
perspicillatus, Scarus, 2, 4, 5, 31, 36, *57*, 58 (fig.)
Petronason, 30
philippinus, Callyodon, 95
pindae, Callyodon, 96
pinguirostratus, Scarus, 50
platodoni, Pseudoscarus, 62
pleianus, Scarus, 104
plumbeus, Pseudoscarus, 105
prasiognathus, Scarus, 12
pronus, Scarus, 75
Pseudoscarus, 30
aeruginosus, 69, 96
altipinnis, 86
augustinus, 11
arabicus, 11
aracanga, 12, 107
balinensis, 56, 61
bataviensis, 64
bicolor, 27
brevifilis, 76
californiensis, 91
cantori, 85
capistratoides, 74
caudofasciatus, 92
caudofasciatus zonularis, 92
celebicus, 68
chloromelas, 66
chrysopoma, 95
collana eques, 59
cyanognathos, 100
cyanotaenia, 64
dimidiatus, 74
dussumieri, 100
falcipinnis, 75
filholi, 64
flavomaculatus, 92
flavomarginatus, 93
forskalii fuscopurpureus, 62
forsteni, 81
forsteri, 64
frenatus, 52, 83
frontalis, 13, 26
Pseudoscarus—Continued
garretti, 84
ghobban, 84
gnathodus, 103
godeffroyi, 86
goldiei, 69
guacamaia, 13
gymnognathus, 68
heliotropinus, 21
hoefleri, 109
hypselopterus, 54
ismaillius, 12
janthochir, 83
javanicus, 52
jonesi, 72
jordani, 21
knerii, 93
labiosus, 12
lineolatus, 107, 109
macrocheilus, 50
maculiceps, 12
madagascariensis, 93
margaritus, 69
mastax, 50
microcheilos, 48
microrhinos, 48
moensi, 54
moresbyensis, 12
muricatus, 26
natalensis, 85
nigripinnis, 29
nuchipunctatus, 93
papuensis, 12
pectoralis, 100
pentazona, 60, 92
platodoni, 62
plumbeus, 105
pulchellus, 28
quoyi, 68
rhodurupterus, 67
rivulatus, 82, 95
rostratus, 13, 54
rubroviolaceus, 21
schlegeli, 59
simplex, 105
singaporensis, 78
spilonotus, 75
spinus, 56
sumbawensis, 68
taeniopterus, 107
troschelii, 67
troschelii flavoguttata, 69
viridis, 95

Pseudoscarus—Continued
vitriolinus, 69
xanthopleura, 86
zonatus, 93
psittacus, Callyodon, 13, 114
Coryphaena, 13, 29
Scarus, 13, 29, 30, 50
pulchellus, Cetoscarus, 28
Chlorurus, 4, 5, 20, 26, *28*
Pseudoscarus, 28
Scarua, 25, 28
punctulatus, Scarus, 13, 102, 107, 108
pyrrhurus, Callyodon, 62
pyrrostethus, Scarus, 84
pyrrostethus australianus, Scarus, 84

quadrispinosus, Scarus, 12
quoyi, Pseudoscarus, 68
Scarus, 13, 64, 68, 95

radians, Scarus, 110, 113
Sparisoma, 6, 111, *113*, 122, 123
randalli, Scarus, 4, 6, 32, 46 (fig.) *97*
rarotongae, Scarichthys, 124
reticulata, Scarus, 30, 84
retractus, Callyodon, 128
rhodurupterus, Pseudoscarus, 67
Scarus, 4, 5, 31, 37, 59, 61, 63, *67*
Xanothon, 67
rhomaleum, Sparisoma, 117
rivulatoides, Scarus, 82
rivulatus, Pseudoscarus, 82, 95
Scarus, 82
rosiceps, Scarus, 12
roseus, Cryptotomus, 4, 5, 123, 124, *127*
rostratus, Callyodon, 69
Pseudoscarus, 13, 54
Scarus, 13, 105
ruberrimus, Callyodon, 21
rubiginosus, Scarus, 130
rubripinnis, Scarus, 118
Sparisoma, 4, 6, 13, 112, *118*
rubrofasciatus, Callyodon, 79
Scarus, 4, 32, 40, *79*
rubronotatus, Scarus, 126
rubroviolaceus, Callyodon, 21
Pseudoscarus, 21
Scarops, 4, 5, 19, 20, *21*, 95, 131
Scarus, 18, 21
ruppelii, Scarus, 50
russelei, Scarus, 12

sandwicensis, Callyodon, 124
scaber, Callyodon, 92
Scarus, 4, 6, 13, 32, 45, 61, *92*
scabriusculus, Scarus, 84
Scarichthys, 126
auritus, 126
coeruleopunctatus, 126
naevius, 126
rarotongae, 124
Scaridae, 5 (table), 6 (table), *15*, 16 (key)
Scaridea, 4, 6, 10, 17, *109*
aerosa, 110
balia, 110
farrandi, 110
leucotaeniata, 69, 71
octodon, 113
zonarcha, 4, 6, *109*
Scarinae, 4, 7, 15, *18*
Scarops, 4, 5, 7, 9, 10, 16, *18*, 19 (key), 20 (table), 23
jordani, 4, 5, 11, 19 (fig.), 20, *21*
microps, 4
perrico, 4, 5, 19, 20, *23*, 24 (fig.)
rubroviolaceus, 4, 5, 19, 20, *21*, 95, 131
subg., 10, 16, *18*, 19, 20 (table), *21*
Scarus, 4, 5, 7, 9, 12, 16, 18, 23, *29*, 33 (key)
acutus, 103
aeruginosus, 4, 6, 12, 32, 44, 46, 54, *96*
africanus, 4, 32, 40, *75*
ahula, 36, 57, 59
alternans, 106, 109
amplus, 122
aracanga, 12, 107
arcuatus, 11
atomarius, 113
atropectoralis, 5, 32, 41, *79*
auritius, 126
aurofrenatus, 115
axillaris, 117
azureus, 6, 11, 32, 43, 44 (fig.), *89*, 91
balinensis, 61
barborus, 57, 59
bataviensis, 64, 65
bennetti, 12, 54, 96
bicolor, 27
bipallidus, *131* (fig.)
bleekeri, 5, 13, 31, 38, *68*

Scarus—Continued
blochi, 6, 13, 32, 46, *95*
bollmani, 107
bottae, 126
bowersi, 5, 31, 39, *72*, 73, 74
brachiale, 13
brachialis, 120
brachyvarius, 117
brevifilis, 4, 5, 32, 40, *76*, 79
brighami, 72
brunneus, 62, 63
caeruleo-punctatus, 126
caerulescens, 11
californiensis, 4, 6, 32, 44, 45 (fig.), 90, *91*
calus, 21
canariensis, 130
capistratoides, 5, 31, 39, 63, 71, *74*
capistratus, 11
capitaneus, 66
catesbaei, 114
catesbyi, 114
caudofasciatus, 59
chloris, 11, 118
chlorodon, 5, 32, 43 (fig.), *86*
chrysopterum, 120
chrysopomus, 95
circumnotatus, 118
coccineus, 121
coelestinus, 6, 13, 101, 102, 104, *105*
coeruleopunctatus, 126
coeruleus, 4, 6, 101, 102, 106
collana, 50
collaris, 50
compressus, 4
cretensis, 11, 12, 50, 130
croicensis, 1, 3, 4, 6, 12, 13, 30, 101, 102, *106*
cruentatus, 11
cuzamilae, 103
cyanescens, 4, 31, 37, *66*
cyanognathos, 99
cyanotaenia, 64
cyanurus, 50
cypho, 59
denticulatus, 11, 12
dentiens, 128
diadema, 107
dimidiatus, 4, 5, 32, 40, *74*
distinctus, 115
dubius, 4, 5, 12, 23, 31, 34, 37, *54*, 96, 97
dussumieri, 6, 11, 32, 47, *100*
Scarus—Continued
emarginatus, 118
emblematicus, 107, 109
enneacanthus, 11
erythacus, 62, 63
erythrinoides, 116
erythrodon, 63, 68
evermanni, 107, 109
fasciatus, 5, 32, 41, 80, *82*
ferrugineus, 11
festivus, 11, 12, 116
flavescens, 11, 12
flavipectoralis, 5, 31, 34, *52*, 80
flavomarginatus, 12, 107
formosus, 5, 31, 35, *56*, 61, 87, 88
forsteri, 4, 5, 13, 31, 37 (fig.), 62, 63, *64*, 65 (fig.)
frenatus, 5, 32, 41, 42 (fig.), 52, *83*
frondosus, 115, 122
frontalis, 11, 13
galena, 62, 63
ghobban, 5, 11, 30, 31, 42, *84*, 91
gibbus, 25, 26
gilberti, 64
globiceps, 4, 5, 32, 40, *75*, 83
guacamaia, 4, 6, 13, 18, 30, 101, 103 (fig.), *104*, 105
guttatus, 4, 32, 42 (fig.), 78, 79, *85*
gymnognathus, 68
harid, 3, 4, 5, 13, 29, 30, 31, 33, 34 (fig.), *50*
haridoides, 84
hertit, 84
hildebrandi, 12, 23, 24 (fig.)
hoefleri, 6, 101, 102, *109*
hoplomystax, 113
humeralis, 12
hypselopterus, 54, 97
insulae st. crucis, 106, 108
janthochir, 5, 32, 41, *83*
javanicus, 5, 31, 34, *52*
jenkinsi, 64
jonesi, 5, 31, 39 (fig.), *72*
kraussi, 57
lacerta, 96
lacrimosus, 113
lateralis, 120
latus, 50
lauia, 5, 31, 35 (fig.), *57*
lepidus, 4, 5, 32, 41, 47, 80, *81*
leucostigma, 57
limbatus, 93

Scarus—Continued
longiceps, 50
loro, 106
lunula, 5, 13, 31, 35 (fig.), *54*
lunulatus, 12
lupus, 72
macrocheilos, 50
maculosus, 85
madagascariensis, 4, 32, 45, *94*, 131
makaravar, 12
margaritus, 13
marshalli, 5, 32, 43, *88* (fig.)
maschalespilos, 120
mastax, 50
melanotis, 114
mertensii, 12
micrognathos, 82
microrhinos, 4, 5, 25, 30, 31, 33 (fig.), *48*
mineofrenatus, 115, 116
miniatus, 57
moensi, 54
muricatus, 25, 26
mutabilis, 13, 59, 130
naevius, 126
niger, 4, 6, 12, 32, 45, 46 (fig.), 66, *93*, 94
nigrans, 12
nigrescens, 103
noyesi, 4, 6, 11, 32, 44 (fig.), 85, *90*
nuchalis, 106
nuchipunctatus, 93
obtusus, 106
ocellatus, 27
oedema, 4, 5, 31, 33, *48*, 67
oktodon, 64
ophthalmistius, 27
oviceps, 6, 32, 45, 92, *93*
oxybrachius, 116
paluca, 21
pectoralis, 6, 32, 47, 92, *99* (fig.)
pentazona, 61
pepo, 30, 84
perrico, 23
perspicillatus, 2, 4, 5, 31, 36, *57*, 58 (fig.)
pinguirostratus, 50
pleianus, 104
prasiognathus, 12
pronus, 75
psittacus, 13, 29, 30, 50
pulchellus, 25, 28
punctulatus, 13, 102, 107, 108
Scarus—Continued
pyrrostethus, 84
pyrrostethus australianus, 84
quadrispinosus, 12
quoyi, 13, 64, 68, 95
radians, 110, 113
randalli, 4, 6, 32, 46 (fig.), *97*
reticulata, 30, 84
rhoduropterus, 4, 5, 31, 37, 59, 61, 63, *67*
rivulatoides, 82
rivulatus, 82
roseiceps, 12
rostratus, 13, 105
rubiginosus, 130
rubripinnis, 118
rubrofasciatus, 4, 32, 40, *79*
rubronotatus, 126
rubroviolaceous, 18, 21
ruppelii, 50
russelei, 12
scaber, 4, 6, 13, 32, 45, 61, *92*
scabriusculus, 84
schlegeli, 4, 5, 31, 36, *59*, 92
sexvittatus, 12
singaporensis, 4, 5, 32, 40, *78*
sordidus, 2, 4, 5, 13, 30, 31, 38 (fig.), 65, 67, *68*, 73, 96, 131
spilurus, 12
spinidens, 13, 117, 124
squalidus, 120
striatus, 50
strigatus, 130
strongylocephalus, 48
sumbawensis, 68
superbus, 103
taeniopterus, 107
taeniurus, 5, 31, 36 (fig.), *61*, 65
toshi, 12
tricolor, 81
trilobatus, 106
trispinosus, 12
troscheli, 5, 31, 37, 38 (fig.), *67*
truncatus, 118
turchesius, 104
vaigiensis, 126
variegatus, 68
venosus, 5, 31, 36, 59, *60*, 61 (fig.), 92
vermiculatus, 5, 32, 41, *82*
vetula, 4, 6, 101, 102, *103* (fig.)
virens, 118
virginalis, 107

Scarus—Continued
viridescens, 124
viridis, 12, 13, 114
visayanus, 81
xanthopleura, 86
zonularis, 59
subg., 16, 31–32 (table), 48, 57, 117
schlegeli, Pseudoscarus, 59
Scarus, 4, 5, 31, 36, *59*, 92
scriptus, Callyodon, 27
sexvittatus, Scarus, 12
shimoniensis, Callyodon, 26
simplex, Pseudoscarus, 105
singaporensis, Callyodon, 78
Pseudoscarus, 78
Scarus, 4, 5, 32, 40, *78*
snyderi, Calotomus, 124
sordidus, Scarus, 2, 4, 5, 13, 30, 31, 38 (fig.), 65, 67, *68*, 73, 96, 131
Sparisoma, 4, 6, 7, 10, 12, 17, *110* (key), 119, 121, 130
abbotti, 113
abildgaardi, 4, 6, 111, 113, 120, *121*
aurofrenatum, 1, 3, 6, 111 (fig.), 112 (fig.), *115*, 121
axillaris, 6, 13, 112, *117*
chrysopterum, 4, 6, 13, 113, 119, *120*
cyanolene, 113
distinctum, 12, 107, 109, 112, 117
elongatum, 120, 121
flavescens, 118, 119
lorito, 4, 120
niphobles, 113
pachycephalum, 13, 118, 119
radians, 6, 111, *113*, 122, 123
rhomaleum, 117
rubripinnis, 4, 6, 13, 112, *118*
viridis, 6, 13, 111 (fig.), *114*
xystrodon, 113
Sparisomatinae, 4, 7, 16, *109*
Sparus abildgaardi, 110, 121
aureoruber, 122
holocyaneos, 106
speigleri, Callyodon, 100
spilonotus, Pseudoscarus, 75
spilurus, Scarus, 12
spinidens, Callyodon, 125
Calotomus, 4, 6, 13, 123, *124*, 125 (table)
Scarus, 13, 117, 124
spinus, Pseudoscarus, 56
squalidus, Scarus, 120
striatus, Scarus, 50
strigatus, Euscarus, 4, 6, *130*
Scarus, 130
strongylocephalus, Chlorurus, 48
Scarus, 48
sumbawensis, Pseudoscarus, 68
Scarus, 68
superbus, Scarus, 103

taeniopterus, Pseudoscarus, 107
Scarus, 107
taeniurus, Scarus, 5, 31, 36 (fig.), *61*, 65
toshi, Scarus, 12
tricolor, Scarus, 81
trilobatus, Scarus, 106
trispinosus, Scarus, 12
troscheli, Scarus, 5, 31, 37, 38 (fig.), *67*
troschelii, Pseudoscarus, 67
truncatus, Scarus, 118
turchesius, Scarus, 104

ultramarinus, Callyodon, 48
upolensis, Callyodon, 56, 97
ustus, Callyodon, 128, 129
Nicholsina, 4, 6, *128*

vaigiensis, Leptoscarus, 4, 6, *126*
Scarus, 126
variegatus, Scarus, 68
venosus, Scarus, 5, 31, 36, 59, *60*, 61 (fig.), 92
vermiculatus, Callyodon, 76, 82
Scarus, 5, 32, 41, *82*
verweyi, Callyodon, 30, 54
Margaritodon, 54
vetula, Scarus, 4, 6, 101, 102, 103 (fig.)
virens, Scarus, 118
virginalis, Scarus, 107
viridescens, Scarus, 124
viridibusius, Callyodon, 81
viridifucatus, Callyodon, 54, 56
viridis, Pseudoscarus, 95
Scarus, 12, 13, 114
Sparisoma, 6, 13, 111 (fig.), *114*
visayanus, Scarus, 81
vitriolinus, Pseudoscarus, 69

waigensis, Leptoxanus, 126
waigiensis, Callyodon, 124
waitei, Callyodon, 86, 87

Xanothon, 30
bataviensis, 64
bipallidus, 30, 131
capistratoides, 64, 74
capitaneus, 66
carifanus, 62
cyanotaenia, 66
erythrodon, 69
fowleri, 52
frenatus, 52
margaritus, 69
oktodon, 64
parvidens, 64
pentazona, 60
rhoduropterus, 67
xanthopleura, Pseudoscarus, 86
Scarus, 86
xenodon, Calotomus, 4, 123, 124
Xenoscarops, subg., 10, 16, 20 (table), *23*
Xenoscarus, 128
denticulatus, 12, 128, 129
hubbsi, 129
xystrophon, Sparisoma, 113

Ypsiscarus, subg., 9, 10, 16, 31–32 (table), *47*

zonarcha, Scaridea, 4, 6, *109*
zonatus, Pseudoscarus, 93
zonularis, Callyodon, 92
Pseudoscarus caudofasciatus, 92
Scarus, 59

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01421 3011